THE WEEK'S EVENTS

Chicago Subway Gets PWA Grant

City agrees to unify transit and set up fund from revenues for subway extension

The President has approved a PWA grant of $18,000,000 for construction of a subway in Chicago. This represents 45 per cent of the cost of the $40,000,000 project.

The plan adopted is one of two drawn up by a special board of engineers appointed by PWA Administrator Ickes to study the scheme originally submitted by Chicago. The plan adopted expands somewhat the original project submitted by the city.

Award of the grant is based on a promise to PWA by Chicago that the city will at once put through a unification ordinance covering all surface, elevated, and bus services. The proposed ordinance contains a clause requiring the unified transit company to pay a certain share of its gross receipts to the city; these payments will go into an inviolable trust fund to be used exclusively for extension of the subway until a comprehensive subway system has been completed. Thereafter the proceeds will be used for extensions, improvements and rehabilitation generally of the traction system.

The unification ordinance must be approved by PWA in advance of its passage.

Two subway lines

The subway project, as may be seen from the accompanying map, includes construction of the State St. subway from South State St. to the Clybourn Ave. connection of the elevated line. It also includes a subway along Dearborn and Lake St. and Milwaukee Ave. to a connection with the Logan-Humboldt elevated line; this line begins on Dearborn at Congress St.

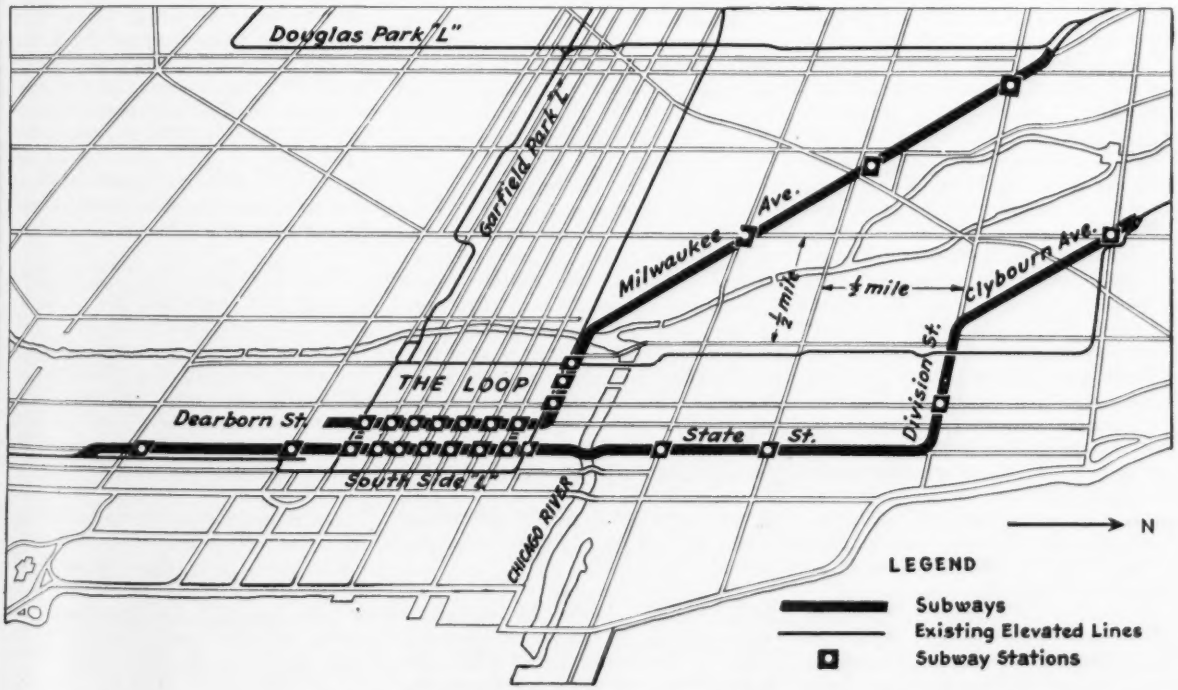
Each of the lines will have continuous loading platforms in the loop area with entrances at every block, and pedestrian tunnels will connect the two stations.

Detroit Stops Using New Incinerators

Burning operations have been suspended at the Northwestern incinerator plant in Detroit, first to be completed of three new PWA-financed incinerators being built under a $1,458,000 program. The incinerator plant will be used as a transfer point where pick-up garbage trucks will transfer their loads to trailers. The garbage will be buried and covered over with earth.

Cost of incineration, according to Commissioner of Public Works Henry E. Beyster, is $2.06 a ton, as compared with a land-fill cost of $.70 a ton. The burying method, he said, will be used until the ground is frozen too hard.

Beyster said that abandonment of the incinerator was influenced by local complaints of odors from the stack. Abandonment, he said, will permit balancing the falling load, which is being distributed to three other incinerator plants and to the land fill. The city's three other incinerators will remain in operation.



PLANS of the New Chicago subway, for which PWA has just made an $18,000,000 grant, call for construction of two lines coming close together in the loop area. Pedestrian subways will connect the two lines at this point.

Traffic Engineers Meet in Chicago

Pedestrian control problems get particular attention from Institute of Traffic Engineers

Although overshadowed in point of numbers by the concurrent meeting of the National Safety Council, the Institute of Traffic Engineers in Chicago last week gave a good account of itself with an excellent program of its own. A few of its sessions were joint meetings with the street and highway traffic section of the National Safety Council. Sessions were devoted to such broad general subjects as pedestrian safety, parking, lighting and express highways.

The pedestrian problem

Pedestrian safety was given particular attention. In discussing the problem, L. J. Sorenson, city traffic engineer of Chicago and president of the institute, stated that persons 65 years or older account for 26 per cent of pedestrian deaths; compared with all other age groups, the chances are 7 to 1 against them. In Cleveland, pedestrian deaths comprise 75 per cent of the total deaths caused by motor vehicles. The drinking pedestrian is becoming an increasingly serious factor in the night accident fatality list. In New York, brain tests of pedestrians killed in traffic accidents showed that 33 per cent had been drinking.

Mr. Sorenson also pointed out that recent studies in Detroit indicate that pedestrian accidents have been reduced 34 per cent by improved street lighting. In Syracuse, while day pedestrian accidents increased 86 per cent, night accidents increased only 22 per cent after lighting was installed. In Denver, if a pedestrian involved in an accident can be proved at fault and responsible for the accident, he may be fined up to fifty dollars and, of course, is responsible for his own hospital bills.

Lawrence Selz, publicity specialist of Chicago, presented an interesting and valuable paper on "How to Sell Traffic Safety," the principal theme of which was to "make recklessness antisocial." It is necessary, he said, that people feel that violation of traffic regulations is just as much a crime as the violation of any other laws.

In commenting on the fact that in this country motor vehicle deaths for 1938 are approximately 22 per cent under those of 1937 for the same period of time, Miller McClintock, head of the Yale Bureau of Street and Highway Traffic, stated that "There is nothing so demoralizing as a sense of satisfaction." He feels that we now face our greatest danger in the traffic problem, as there may be an inclination to "rest on the oars."

At a session of the street and highway traffic section on Tuesday afternoon, Oscar M. Gunderson, traffic engineer, Michigan state police, in discussing the use of spot maps for locating motor vehicle fatalities, pointed out that there is a considerable variation from year to year. For instance, the points representing excessive fatalities for the year 1938 do not superimpose upon a similar spot map showing the fatalities for 1937. He pointed out, however, that concentration of fatalities on these spot maps usually indicates spots where study and corrective remedies are needed on the highway system. At this same session D. G. Reynolds of the accident prevention bureau, Miami, Florida, police department, stated that they have a ratio of 35 injuries and $150 property damages to each fatality.

Highway lining

At a Wednesday morning meeting of the street and highway traffic section, in a separate group meeting of the state highway officials, it was brought out that there still is a need of uniformity in traffic regulations in various parts of the country. This is particularly true in connection with signs and pavement markings. For instance, in line with the recent trend toward painting auxiliary lines parallel to and different in color from the center line on curves and hills, it was shown that while many states follow the rule that this auxiliary line (indicating that no crossing of the center line is allowed) should be on the side of the centerline adjacent to the motorist, in California it is just the opposite. In this latter state the motorist may cross the double centerline if the auxiliary line is in his traffic lane but may not cross the centerline if the auxiliary traffic line is on the opposite side of the centerline from the lane in which he is travelling. Naturally, this is exceedingly confusing and probably contributes to accidents in the case of cross-country motorists. It was pointed out, also, that many of these markings are based on sight distances for passing of 750 ft. while recent studies have shown that, in passing a motor vehicle ahead travelling at 50 m.p.h., 1,150 ft. of passing distance is required.

The annual banquet was addressed by Thomas H. MacDonald, chief U. S. Bureau of Public Roads, who discussed some of the results of the nationwide highway survey. Present officers, consisting of Leslie J. Sorenson, president, Hawley S. Simpson, vice president, and Harold F. Hammond, Secretary-treasurer, were reelected.

L. A. Ball, Consultant Dies in New York

Other deaths include Eldredge, engineer on Lincoln Tunnel, and Hough, tunnel builder

Laurence A. Ball, for twenty years a member of the New York consulting firm of Ball & Snyder, died last week in New York at the age of 56. Ball was associated with Ralph Modjeski and George S. Webster on the construction of the $40,000,000 Delaware River bridge between Philadelphia and Camden. He also designed a section of the I.R.T. subway, the Riker's Island prison, and most recently the stadium at the World's Fair grounds.

After graduating in 1900 from the College of the City of New York, Ball worked briefly for various bridge companies and in 1903 became structural engineer for Reed & Stem, architects. Six years later he went to work for the Hay Foundry & Iron Works in Newark and entered private practice in 1911. He formed his partnership with Snyder in 1918.

ROBERT ELDREDGE, supervising engineer for PWA on the Lincoln Tunnel in New York City, died there Oct. 12 at the age of 64. Eldredge was for some years supervising engineer for the T. A. Gillespie Co. on the construction of New York's first subways. After working on dam construction in the West and in Spain, he returned for a time to the Gillespie company and in the early 20's became manager of construction for The Foundation Co. He left that post in 1933 and joined the PWA staff as supervising engineer on construction of the Independent subway and later was placed in charge of the Lincoln tunnel project.

DAVID L. HOUGH, New York City civil engineer and contractor, died at Amityville, L. I., last week at the age of 73. Hough graduated from the Sheffield Scientific School of Yale University in 1885, and ten years later he began private practice in New York as a consulting engineer and contractor. He built one of the first tunnels under the East River, a gas conveyor, and later was a contractor on Interborough subway construction and on the two cross-town tunnels of the Pennsylvania R. R. He served as a captain of engineers in the Spanish American war and served with the rank of major in the engineers during the World War.

JOHN A. HARRISS, who, as special deputy police commissioner of New York from 1918 to 1925, introduced the traffic signal light system there, died

Oct. 11 in New York City at the age of 63. After he left the police force, Harriss was traffic chairman of the City Planning Committee and headed the Citizens Street Traffic Committee of New York.

LESLIE BOWEN, engineer for the Bureau of Reclamation stationed for the past six years at Scottsbluff, Nebr., died in Cheyenne Oct. 14 at the age of 40.

CARL F. UHDEN, 65, retired hydraulic engineer of Seattle and Spokane, died in Seattle Oct. 11. Uhden worked for many years for the Washington Water Power Co. of Spokane and supervised construction of several hydro-electric plants for that firm. He was chief engineer on construction of the Gorge Creek power plant at Seattle and later was engineering superintendent of the Skagit Power Development Co.

CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week, $65,224,000, are 59 per cent higher than in the corresponding 1937 week. This is the 14th consecutive week in which construction volume has exceeded its 1937 values.

Cumulative construction awards for 42 weeks of 1938 total $2,182,024,000, an increase of 8.6 per cent over the volume for the corresponding period last year.

Public awards are 166 per cent above a year ago due to the large volume of public building and highway projects getting under way. Private construction is 33 per cent lower than a year ago.

Public building awards for the week, $15,600,000, are the second highest of the year. This volume together with $14,700,000 in highway lettings, makes up 60 per cent of the week's public total. In addition to these two construction groups, waterworks, sewerage, bridges, and earthwork and drainage also report gains over the 1937 week. All classes of construction except unclassified are higher than in the short preceding week.

New capital for construction purposes for the week, $74,155,000, is 346 per cent higher than for the corresponding week in 1937. The week's new financing is made up of $52,096,000 in PWA allotments for non-federal projects, $11,493,000 in state and municipal bonds, $6,916,000 in PWA allotments for federal projects, $3,000,000 in RFC loans, and $650,000 in corporate security issues.

New construction capital for 1938 to date totals $3,291,732,000, a 59 per cent gain over the volume for the 42-week period a year ago.

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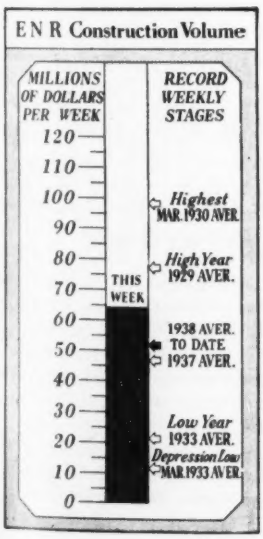

CONTRACTS

(Thousands of dollars)

	Week Ending Oct. 21 1937	Oct. 13 1938	Oct 20 1938
Federal	$3,079	$9,159	$10,712
State & Municipal	15,786	25,582	39,491
Total public	$18,865	$34,741	$50,203
Total private	22,281	14,345	15,021
TOTALS	$41,146	$49,086	$65,224
Cumulative 1938 (42 weeks)			$2,182,024*
1937 (42 weeks)			$2,010,143

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.
* Revised; $4,500,000 commercial building project abandoned.

NEW PRODUCTIVE CAPITAL

	Cumulative 1937 42 Wk.	1938 42 Wk.
NON-FEDERAL	$1,320,282	$2,148,087
Corporate securities	488,596	334,731
State & Mun. bonds	423,621	490,431
PWA loans, grants	178,126	764,490
RFC loans	29,939	100,128
U.S.H.A. loans	.....	202,807
R.E.A. loans	.....	54,000
Federal Aid-highways	200,000	201,500
FEDERAL	$746,223	$1,143,645
TOTAL CAPITAL	$2,066,505	$3,291,732

FHA MORTGAGES

	Cumulative 1937 41 Wk.	1938 41 Wk.
Mortg. selected for appraisal	$492,907	$794,681

ENR INDEX NUMBERS

Index Base		1913	1926
Construction Cost	Oct.	234.30	112.63
Building Cost	Oct.	195.48	105.67
Volume	Sept.	213	93

California Explains Licensing Stand

Registration board says it has licensed most Oregon applicants without examination

California law does not permit the state board of registration to enter into reciprocal licensing agreements with other states, the board pointed out in a statement send Oct. 7 to the Oregon state board of engineering examiners. The statement was sent in comment on the Oregon board's decision last month not to recognize the possession of a California civil engineering license as sufficient qualification for receipt of a license from Oregon (*ENR* Sept. 22, 1938, p. 345).

In taking this action, the Oregon board drew attention to the refusal of the California board to enter into an interstate agreement for reciprocal licensing adopted last May by Oregon, Washington, and Idaho and to a statement said to have been made by the California board that it did not consider the Oregon examination comparable to its own.

The Oct. 7 statement of the California board pointed out that California law does not provide for reciprocal registration. The law does permit the board to grant registration to a registrant in another state without examination if the standards of the state issuing the original registration are not lower than those of California; the board interprets this to imply that the qualifications of each applicant must be those required in California.

"The California board," the statement pointed out, "has shown its confidence in and respect for the administration of the Oregon law by the Oregon state board of engineering examiners in granting registration to 47 Oregon registrants based solely upon their Oregon registration and without written examination. . . . Since 1929, only five applicants registered in Oregon have been denied registration."

The California board also denied having made any sweeping statement that the Oregon examinations were not comparable to those given in California. In the case of one applicant, "who obtained his registration in Oregon under unusual circumstances," the California board informed him that the Oregon examination did not meet California standards.

Despite the action of the Oregon board, it was stated, the California board will continue to receive applications from Oregon registrants and will grant registration without written examination to those who qualify under the California standards.

Sawyer Nominated To Head A.S.C.E.

Strengthening of technical divisions of the society begun by the board of direction

Donald H. Sawyer, special assistant to the director of procurement, U.S. Treasury Department, was chosen as official nominee for president of the American Society of Civil Engineers at the fall meeting of the society at Rochester, N. Y., Oct. 12–14. The nomination is made by the board of direction and two past presidents sitting as a nominating committee. The board also had to name an official nominee for vice president of Zone II due to the death on Sept. 24 of Richard Khuen, Jr., who had received the largest number of the votes. The board named Charles M. Reppert, president of the Pittsburgh section. Election of officers takes place in January.

Subsequent to the meeting, tellers appointed to canvass the ballot for official nominees announced that the vote for vice-president in Zone III where there has been a keen contest stood as follows: James L. Ferebee, 394; Charles B. Burdick, 368; Clyde T. Morris, 309; Theodore A. Leisen, 256.

Other actions taken by the board included strengthening of the technical divisions through increased terms for officers, realignment of boundaries of zones and districts, abolishing the research committee, and setting up a hydraulics division.

Divisions strengthened

Five-year appointments to executive committees of the divisions are as follows: City Planning, Harland Bartholomew; Construction, David Bonner; Engineering Economics, J. H. Porter; Highways, C. E. Myers; Irrigation, H. C. Neuffer; Sanitary Engineering, A. Clinton Decker; Power, Phillip Sporn; Soil Mechanics and Foundations, Carlton S. Proctor; Structural, G. B. Woodruff; Surveying and Mapping, W. N. Brown; Waterways, R. E. Bakenhus; Hydraulics, F. C. Scobey. The hydraulics division is new. The four members named to the executive committee for shorter terms are as follows: G. H. Matthes, B. A. Bakhmeteff, J. C. Stevens and C. H. Paul.

Awards announced

Prize winners as follows were announced: The Norman Medal to Hunter Rouse for his paper on "Modern Conceptions of the Mechanics of Fluid Turbulence"; J. James R. Croes Medal to E. C. Hartman for his paper on "Structural Application of Aluminum Alloys"; James Laurie Prize to Leon S. Moisseiff for his paper on "Evolution of High Strength Steel Used in Structural Engineering"; Arthur M. Wellington Prize to Charles M. Noble for his paper on "The Modern Express Highway"; Collingwood Prize for juniors to Douglas M. Stewart for his paper on "Behavior of Stationary Wire Ropes in Tension and Bending".

DONALD H. SAWYER

PWA attacked and defended

Not on the program was an interview by some newspaper reporters of Henry E. Riggs, president of the society, in which President Riggs characterized some of the projects being built by the PWA as "no more useful than the pyramids of Egypt." Riggs said that the government would have done better to have spread the money spent on projects like Grand Coulee over the nation for useful things such as bridges, grade separations, sewers and streets.

Publication of this interview in the New York *Times* of Oct. 10 brought a quick rejoinder from Henry M. Waite, consultant to the Public Works Administration, in the form of a letter sent to Riggs, to members of the board, and to the press. Waite asserted that the philosophy expressed by Dr. Riggs in his capacity as president of the American Society of Civil Engineers did not reflect the views of the majority of the society's membership. Among those helped by the large expenditures of the federal government, said Waite, "are all classes of engineers and architects in the country, a large number of whom are members of the society of which you are president and for whom you make these denunciatory statements."

Advance Planning By U.S.B.R. Urged

Page tells Reclamation Association that bureau needs funds to study possible sites

Provision of funds which would permit the U. S. Bureau of Reclamation to make an advance investigation of possible reclamation projects was urged by Commissioner of Reclamation John C. Page in a speech delivered at the Reno meeting of the National Reclamation Association Oct. 11-13.

Page pointed out that collections now coming in to the Reclamation Fund are not sufficient to carry the expanded construction program now under way and that if progress is to continue substantial new Congressional appropriations will be necessary during the continuance of the present program. Construction now planned will provide about 150,000 acres of new irrigated land each year over the next six years, he said.

Appointment of a national resources sub-committee to study western water laws was announced. A. E. Chandler of San Francisco is chairman.

A resolution adopted by the association urged that the National Resources Committee be given Congressional standing, with the membership selected to represent various areas; the resolution expressed opposition to proposals to establish regional authorities throughout the country.

Other resolutions expressed the satisfaction of the association with the report of the Repayment Commission and urged that the commission be continued and make further recommendations until a repayment plan is enacted into law.

After some disagreement, a resolution was adopted supporting the state ownership of water and urging the state attorney general to file briefs whenever the Department of Justice reiterates its position that unassigned waters belong to the federal government.

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Detroit Vehicle Subway Put on Ballot

Detroit voters will have an opportunity next November to express their opinion of a $42,000,000 project for constructing two vehicle subways, one under Woodward Ave. from Highland Park to Jefferson Ave. and the other under Grand Boulevard from Tireman Ave. to Joseph Campau Ave. The common council has decided to put an advisory vote on the project on the ballot.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

ALL PREVIOUS RECORDS for getting PWA jobs under way have been broken in the present program. On Oct. 17 work had started on 2,479 projects, of which 1,454 were non-federal, and 60 projects were going into construction daily. Projects under way on that date had a total construction value of $551,276,000.

The number of projects reaching the building stage in the first three months of the new program is more than three times the number put under construction in the same period under any previous program.

JURISDICTION of the Federal Power Commission over the upper reaches of the Susquehanna has been denied by the Pennsylvania Water and Power Co. Answering an order from FPC to show cause why proceedings should not be instituted against it for operating the 150,000-hp. Holtwood hydroelectric development on the Susquehanna near Holtwood, Pa., without a license, the company asserted that the Susquehanna at Holtwood is not a navigable water of the United States.

REDUCTION last February of the down payment on FHA-insured mortgages to 10 per cent has immensely increased the activity of that agency. Although business conditions at that time were bad, mortgages selected for appraisal, which had been running in the neighborhood of $50,000,000 per month, jumped to $95,161,000 in March, $97,232,000 in June, and $104,227,000 in August. They dropped slightly to $98,432,000 in September with the seasonal trend, but the increase in the September total over the same month of 1937 was 117 per cent.

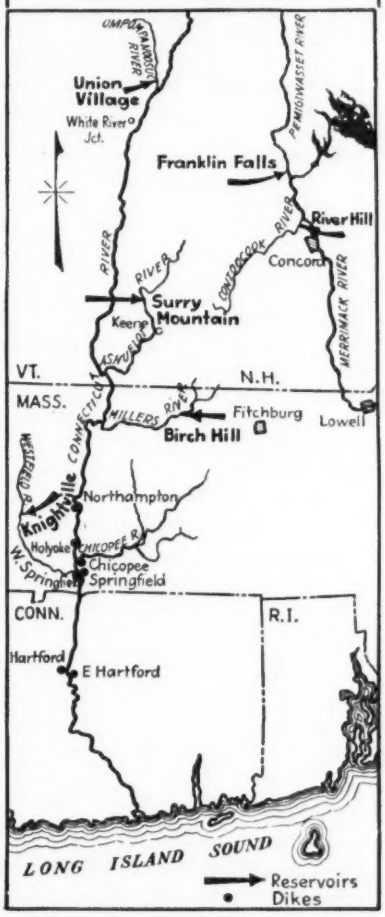
Financing of large scale developments has also shown a distinct upturn. A total of 94 large-scale projects with a total value of about $7,000,000 is now under way or completed.

USE OF RELIEF FUNDS in the northern great plains area to permit construction of small reclamation projects on which full repayment cannot reasonably be expected is recommended in a preliminary report of the Great Plains Committee made public Oct. 14.

It is urged that the projects be constructed by the federal agencies best adapted to the work involved but that plans of all large projects be approved by the Bureau of Reclamation.

AFTER Secretary Ickes dedicated the Imperial dam last weekend it was necessary to close the headgates of the All American Canal until the water carries a greater quantity of silt. This is needed to seal the first twenty miles of the canal, the sector which is now complete. The water admitted in connection with the dedication ceremonies was dropped into the head of the Imperial Canal through the Pilot Knob wasteway.

WHERE MONEY WILL BE USED FOR NEW ENGLAND FLOOD CONTROL



SHOWN ABOVE are the locations at which flood control work is to start immediately in New England. As noted last week (*ENR* Oct. 13, 1938, p. 447), the War Department, PWA and WPA have allotted a total of $11,500,000 for immediate start on projects previously authorized by Congress. Under the terms of the 1938 flood control act, the entire cost of these projects will be borne by the federal government.

Bids will be asked first on reservoirs at Union Village, Vt., Surry Mountain and Franklin Falls, N. H., and Knightville, Mass. Plans are not complete for River Hill and Birch Hill reservoirs.

LABOR NOTES

THE CONTROVERSY between the Seattle Building Trades Council and the Seattle chapter of the Associated General Contractors over renewal of an agreement providing for the six-hour day has been ended by signing of the renewal. The new agreement runs until June 1, 1940. Earlier this year there was a general strike on Seattle construction over the six hour day clause, the strike being terminated when both parties agreed to submit the matter to arbitration, with the old contract in force meanwhile.

The new agreement provides for the same wages and hours as heretofore. One change prohibits rotation of men unless both unions and employers agree and another stipulates that the union will not furnish men to employers unless the employers have registered and are complying with the workmen's compensation act, the state business and occupational tax, and state and federal social security laws.

THE PHILADELPHIA city council on Oct. 14 terminated a strike of city ash and garbage collectors when it appropriated extra money to the bureau of street cleaning to provide for reinstatement of 264 men whose dismissal caused the walkout.

THE STATE of Nevada was picketed by the C.I.O. in an unprecedented action last week. Carrying signs, "The State of Nevada is unfair to organized labor," pickets patrolled the main roads leading into the state at the California-Nevada border.

The action was a protest against sheriff's deputies of Washoe County preventing C.I.O. members from entering the state to picket a highway construction job on which the Isbell Construction Co. is contractor. The work involved is on Highway 40. The C.I.O. Tunnel Construction Workers Organizing Committee has a closed shop contract for similar work being done on the California side of the border on the same highway.

A REVISED wage scale has been approved by the Department of Labor for work on the $44,000,000 Colorado-Big Thompson project. The new scale, which was submitted to all contractors planning to bid on the Green Mountain dam project, provides for a common labor rate of 62½ cents an hour as compared with 50 to 55 cents on the original scale. Semi-skilled wages range from 70 to 80 cents and for skilled labor from $1.10 to $1.50 an hour.

Steel Fabricators Foresee Increase in Volume

Improvement of technical and business methods leads in discussions at AISC convention

Increase in bridge and building work from its present low level was forecast by statistical estimates as well as general sentiment at the 16th annual convention of the American Institute of Steel Construction, held at French Lick Springs, Ind., Oct. 11-14. Figures compiled by the Institute show for eight months of 1938 a loss of 43 per cent from the preceding year, bringing the industry down to its 1935 rate. The drop continued from the middle of 1937 to March, since when there has been a continuous slight rise; PWA construction and improving industries demand are counted on for increased activity especially during 1939. R. T. Brooks, executive vice-president, stated that 1,000,000 tons is a conservative estimate of the structural steel to be used in the PWA program and that the industry will be called upon to furnish the larger part of this tonnage during 1939.

The drop in industrial demand for steelwork was reflected in figures cited by T. H. Hendrix, director of statistics, who reported that in the first seven months of 1938 public buying accounted for a larger percentage of fabricated steel production than in the two preceding years, "51.2 per cent of our sales in these seven months being for government work (federal, state and municipal) against 40 per cent in 1937 and 49 per cent in 1936." A sharp downward trend of prices of fabricated steel with decrease in volume was shown by a chart submitted by Mr. Hendrix. While the chart does not include 1938 data, it was admitted that a similar drop is represented by the prices that have prevailed this year.

Forecasting construction

Substantial gains in construction were predicted by Lowell J. Chawner, of the U. S. Department of Commerce, in an address to the convention. From a study of present conditions that control demand he concluded that residential building may increase 40 per cent in 1939; factory construction 30 per cent; commercial building possibly as much as 15 per cent; and utility construction 20 per cent—the latter figure excluding railroads, for which no gain was forecast.

These estimates were an outgrowth of studies by the Division of Economic Research of the Bureau of Foreign and Domestic Commerce to discover the influences on which construction activity depends. As outlined by Mr. Chawner the principal studies to date have dealt with residential and industrial construction. A formula for computing changes in rents, involving number of families, number of available houses, family income, and the claims of other necessaries, was found to account for 98 per cent of the reported variation in the rent index from 1913 to 1937 inclusive; the computed result led the actual by a period of nine months.

Residential building activity was then correlated with number of new families, average family income, cost of ownership, and available market for houses. A formula based on these factors agreed closely with the number of houses built each year from 1914 to 1937, except for 1918 and 1919, when government restrictions on building disturbed the relation. As to factory building Mr. Chawner said, "It appears likely that earnings of manufacturing corporations tend to lead factory building contracts by about three months."

Costs of fabrication

The need for correct cost accounting in keeping a fabricating business on a sound basis was strongly emphasized in the meeting. One session was devoted to discussion of data on the cost of orders under 100 tons presented by Carl Blim (Utica Structural Steel, Inc., Utica, N. Y.). He reported average drafting costs of $5.77 to $6.57 per ton for jobs below 5 tons, against $2.66 per ton for 50- to 100-ton jobs; and shop costs of $9.72 to $12.19 per ton for the former, against $4.91 for the latter. Highly fabricated work, as skew framing, showed still larger differences, drafting costs of $8.59 to $14.45 and shop costs of $16.39 to $21.86 for very small jobs, compared with drafting cost of $2.26 and shop cost of $6.23 for 100-ton jobs. These figures cover only the direct labor charges, without overhead; it was pointed out in discussion that overhead, cost of travel and lost time on small jobs often greatly exceed the charges on large jobs.

In connection with overhead expense, R. T. Brooks presented an analysis of the volume trend during the three decades beginning with 1910, 1920 and 1930 respectively, which showed the demand during the current decade to approximate a horizontal trend 60 per cent below that of the preceding decade. He urged the industry to take this trend fully into account with a view to making its cost-accounting and sales policies accord with the facts.

Industry service

Internal activities of the Institute during the year as reported by V. G. Iden, secretary, included improvement of contract forms, correction of discriminatory bond premium rates, revision of the code of standard practice, a new cost survey, and the several bridge competitions. The work on elevated highways is to be continued, the committee in charge having been reappointed and enlarged.

Much important research work was completed during the year, according to Jonathan Jones, chairman of the committee on technical research, and F. H. Frankland, chief engineer. A final report on measurements of wind effect on the Empire State Building has just been published (*Proceedings* Am. Soc. C. E., Sept., 1938). Tests on rigid-frame knees and large-scale full frames were completed and will soon be covered by a report. Based on these tests a manual of safe design methods is to be prepared. A report on battledeck floor tests and a booklet of design data on such floors were also published

Tests to determine the efficiency of plate-girder splices are in progress at Columbia. Tests of web stiffener spacing are proposed to be made at Ohio State. Other projected researches are on strength of short columns and on riveting of filler plates.

The Institute's new (1936) specification for design of steelwork based on 20,000 lb. stress has been adopted or is permitted by 328 cities and 19 other public bodies, Mr. Frankland reported.

Papers presented before the convention included a discussion of the trade association's place in the advancement of industry, by Dr. Willard L. Thorp (Dun & Bradstreet, New York); a paper on marketing, by Victor J. Brown (Gillette Publishing Co., Chicago); and an address on street improvement, by Dr. Miller McClintock (Yale University, New Haven).

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Connecticut Dams To Be Inventoried

The Connecticut Water Commission is undertaking an inventory of all dams in the state as a WPA project. Each dam will be listed as to location, date of construction, size and type of construction and condition.

On the basis of the survey, Water Commissioner Sanford H. Wadhams plans to establish a priority list for repair and reconstruction.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Regional Flood Control

Sir: In connection with the expression of ideas in "Planned Flood Control" in your issue of May 26, p. 739, the following thoughts occur to me. Whereas your objection to a regional division of the country for purposes of flood control may be sound from the point of view of the rest of the country outside the TVA area, it certainly does not hold in the area under the Authority. In other words the TVA area is getting flood control and the rest is not. Similar authorities in other areas could do similar jobs for the rest of the country. True, there should be a coordinating authority to facilitate a uniform and fair development of the country as a whole—a clearing house so to speak—to which local regional authorities could submit their general plans and which would be charged with holding a balance between projects in various parts of the country.

It seems to me that the fact that the TVA area is over-developed in flood control compared to the other parts of the country is indicative of a lack of programs in the other parts.

Yours for more TVA's.

EUGENE ATWATER

Los Angeles, Calif., Sept. 16, 1938

P. S. My thanks for your fine magazine.

Sign Language

Sir: In regards to "Sign Language Numerals," p. 279, issue of Sept. 1, it has been my experience that any system of signs that requires the observer, especially if inexperienced, to differentiate between right and left hand is confusing.

Our number system contains three groups of three and a zero. For

One — extend either arm upwards 45 deg. from vertical.

Two — extend either arm horizontally, the other arm held by side.

Three — extend either arm downward 45 deg. from horizontal.

Four —place either hand on chest and extend other arm upwards 45 deg. from vertical.

Five — place either hand on chest and extend other arm horizontally.

Six — place either hand on chest and extend other arm downward 45 deg. from horizontal.

Seven —extend both arms upwards 45 deg. from vertical.

Eight — extend both arms horizontally.

Nine —extend both arms downward 45 deg. from horizontal.

Zero — hold both hands horizontal, palms near together, in front of chest.

In teaching this system to a beginner, remind him of the three groups of three and the zero; then caution him to place the number being signalled in its proper group of three, as indicated by the arm held by side, hand placed on chest, or both arms in position, as the case may be; and finally to determine the number by the quadrant in which the extended arm is held.

Thus: **One** is indicated by one arm remaining in place by side and the other arm extended upwards in **First** position, i.e. first in the first group of three. **Five** is indicated as being in the second group of three by one hand placed on chest, and the number itself is indicated by the other arm extended horizontally. **Nine** is indicated as being in the third group of three by the fact that both arms are used in making the signal, and the number is indicated by the arms being in the third, or lower, position. The zero signal is obvious.

R. F. MIRICK

Construction Engineer, Kildeer, N. Dak., Sept. 6, 1938

Engineering Students

Sir: With reference to W. S. Conlon's news report, July 14, p. 37, and the comment of J. J. Moore, p. 164, Aug. 11 issue, it may help if one of the group they are discussing entered the discussion. I am taking that liberty.

I like Mr. Conlon's phrasing "forced out of the profession" for it is strictly true, it is happening to me at this time. But I don't believe the idea of reducing the number of student engineers will help matters, for it would result in "take these or else ——".

Regardless of Mr. Moore's opinion, Mr. Conlon was right about low-cost engineering services; isn't it only logical that if the potential returns of two investments are to be the same the smaller of the pair would be chosen?

Mr. Moore was correct, the colleges do not make promises in any way, but quite a number have placement bureaus. That is the drawback. After a student has spent his time and capital they expect him to further their cause and continue to pay so-called dues in an alumni association. Failure to pay these dues of a few dollars a year deprives him of the use of this placement bureau regardless of the fact that he has spent all his capital to make the school his Alma Mater.

If the student isn't an engineer at the close of his four year course, what is he? If he isn't, the schools had better revamp their course of studies.

Mr. Moore seems to lose sight of the fact that a student engineer has an investment in himself and that he has a right to demand a fair return on that investment, but employers refuse to give this fact any consideration.

These are experiences that I have had and it sure makes it tough to keep your chin up.

I have been out of school seven years (a depression engineer so to speak) and have done practically everything from digging ditches to operating a modern coal cleaner; from being on top of a 45-ft. blackjack at eighteen below to a "spec" on high class construction! not to mention track "paddy," chainman, maintenance man, etc.

It sort of "gripes" when you spent about three weeks continuously on duty with an average of two hours sleep a day to get a lay-off notice when the rush is over—especially when the pay is in the class mentioned by Mr. Conlon.

Maybe I'm wrong, but something is funny when a man cannot interview you fast enough; or get "hail" for spending twenty minutes on maintenance at the end of a shift so that a production line won't be held up in the morning. It might be that I "shine the apple" the wrong way or

(*Continued on adv. p. 21*)

ENGINEERING NEWS-RECORD

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OCTOBER 20, 1938

STRENGTHENING the nation's defensive resources as projected by the President may involve a large amount of construction work. An expenditure of one billion dollars has been mentioned. Much of this of course will go for armament, battleships and the like. The full program, however, according to the Associated Press, calls for expenditures running to five billion dollars by 1940, of which a large part will come from private sources. Thus the electric utilities, which are known to need much new generating capacity, are to be encouraged to expand their capacity to meet war-time needs through termination of the attack which the Administration has made on them for several years; under these conditions the necessary money will be easily obtained from private sources. Railroads are to be urged to modernize their structures and equipment. That work may need government financing, but a definite upturn in car loadings would bring private capital back into the railway field. It is unfortunate that international unrest has to be the stimulant that starts work on what should be normal peace-time activities, but if the new business which these expenditures create proves to be what is needed to get the country back into normally prosperous activity even the pacifists can hardly complain.

Parkways Chosen

WHEN MUNICIPAL OFFICIALS are faced with a proposal to spend funds totaling more than half of the available borrowing capacity of the city on a single public-works project, that project must be important. Last week the New York City authorities faced such a situation, and finally decided in favor of the project, a parkway around the outer boundaries of the boroughs of Brooklyn and Queens. Involved in the decision was the elimination of certain other proposed works, including a court house and some subway improvements. Thus is emphasized once again the prominent place that express roads have come to occupy among municipal public works. Having wide usefulness and popular appeal, relieving traffic congestion, protecting and enhancing property values, they justify themselves (in the minds of taxpayers at least) better than many other types of public works. New York's circumferential drive will also provide a necessary approach to the new Bronx-Whitestone Bridge, further justifying its cost by feeding traffic to a city-owned toll bridge. It was a difficult decision to make, but the New York officials in favoring the $28,000,000 expenditure for a parkway probably acted in the best interests of the city.

Near-Revolution

APPROVAL of the Chicago subway project by the PWA and allocation of an 18 million dollar grant for the work sets the stage for an undertaking of much greater importance than its cost of some 40 million dollars would indicate. To build an operating rapid-transit sytem within the short space of 18 months, as the law requires, seems hardly possible; yet the special board that studied the project for the PWA evidently concluded that it can be done. The city still has to clear away many remaining difficulties of authorization, finance and designing. Even with these out of the way it is certain that an 18-month job can be accomplished only with most skillful organization of the work and highly efficient execution, which means that the job will be well worth watching. Aside from its construction aspects, however, the project represents the most sensational city-development operation of the day. As the realization of many years of scheming, with repeated rejection of fully worked out plans, the job will initiate a near-revolution for Chicago—complete revamping of the city's transportation methods and the beginning of the end of the much-praised and much-condemned Union Loop.

Bridge Railing Research

DESPITE NOTABLE ADVANCE in building greater safety into bridge railings, there is little occasion for satisfaction over the present state of design practice. Such a situation is not the result of a lack of appreciation of the importance of substantial curb and rail design; that appreciation has already won a widespread acceptance if not a following. Rather, the problem today concerns methods of producing a safe rail barrier that will not detract from the appearance of the bridge by its massiveness. The alternative to a rail that resists impact by its mass is obviously one strong enough by virtue of its structural action. But the design of such a rail rests on a knowledge of member proportioning and anchorage details that is now largely lacking. Here is a problem for research that investigators have placed too far down on the list. Searcy Slack, on another page of this issue, draws some conclusions for bridge-rail design from his pioneer investigation several years ago of highway guard-rail design. They are conclusions worth the study of

every bridge designer. But the fact that should be pondered is that Mr. Slack's conclusions rest on the only extensive set of research results available. Without question, there exists a real need for research projects devoted to bridge railing and curb design.

Strengthening Underground Structures

How Toledo solved the ticklish problem of reinforcing its sole water conduit without interrupting service is a story of ingenuity and skillful application of construction methods. To strengthen the conduit it was decided to install an inner lining of iron plate. Construction was complicated by the fact that operations could be carried on only during limited periods at night when the conduit was temporarily unwatered. The description of how this was done, and the manner in which unusual difficulties were overcome, as told in this issue, should be studied by every engineer concerned with water supply or drainage structures. Underground facilities of this type in many cities are being subjected to unanticipated loads, either from heavy traffic or from changes in the elevation of earth cover. The experience at Toledo should supply many helpful suggestions leading to the economical restoration of old and weakened structures. The field is a fruitful one for cooperation between engineers with their theoretical knowledge and contractors with their practical experience.

Traffic Facts

Surprising facts are emerging from the nation-wide highway-planning surveys, according to a brief summary of one phase of the work presented by Thomas H. MacDonald before the Institute of Traffic Engineers a week ago. For example, it has been found that strings of cars follow each other on the road at 50-mile speed with only 1½ sec. spacing, but that fully two-thirds of all cars drive even closer to the one ahead. Another fact discovered is that heavy trucks slow up to 5 m.p.h. when ascending a 6 per cent grade, tying up all the traffic behind them as they slow down. Through these and similar observations, measurement in the field is furnishing proof of the close relation between vehicle performance, road conditions, and human habits, a relation long recognized in general terms. This relation, of course, bears directly on both efficiency and safety of highway travel, and the survey results will undoubtedly pave the way for substantial advances in both. It is to be hoped that prompt publication will make the facts available to everyone as quickly as they are extracted from the field observations, for this is one subject in which even preliminary and tentative results are useful, at little risk of doing harm by putting out figures that may need later correction.

A Test for Industry

SIGNS of reviving activity in industry and business are daily becoming more numerous, and there are predictions of substantial gains in volume to come even before the end of the year. Following on a 12-month stagnation, some of these predictions seem almost fantastic; yet even the most cautious consideration of the facts will show that back of the incipient rise in demand and production there are unusually powerful forces, which are steadily gathering momentum. Among them is the most concentrated outpouring of public funds to create purchasing power that this country or the world has ever known. Such forces, supported by the pressure of investment money, inevitably tend toward an acceleration of activity that will put industrial management under a severe test.

Construction is cast for an important part in the new activity, since much of the government money is going into construction. It is no surprise therefore to see the sudden jump in demand for construction equipment that has occurred during the past few weeks. Nor is it a surprise to find structural steel circles looking forward to an increased 1939 demand from PWA construction alone that equals the full volume of 1938 output—aside from the requirements of new factory and utility building and of the construction entailed by the national defense program. While not every industry serving construction may experience such effects, many of them are certain to do so.

So profound a change from depression dullness challenges industry to reshape its policies accordingly. Neither the practices of the buoyant days of 1936-37 nor those of the subsequent precipitous decline are likely to serve during the next twelve months. The test is whether industry can manage its affairs so wisely that the revival started by artificial stimulation will be transformed into a maintained momentum.

For one thing, the optimistic overstocking and overproducing of the recent past should not recur. A keener appraisal of coming requirements and more precise forecasting are required if sound policies of production, service and finance are to be developed. Also, the disastrous results of unsound pricing policies were so evident in the 1937 boom and collapse as to assure a wiser approach to price questions in the industrial revival which has now begun.

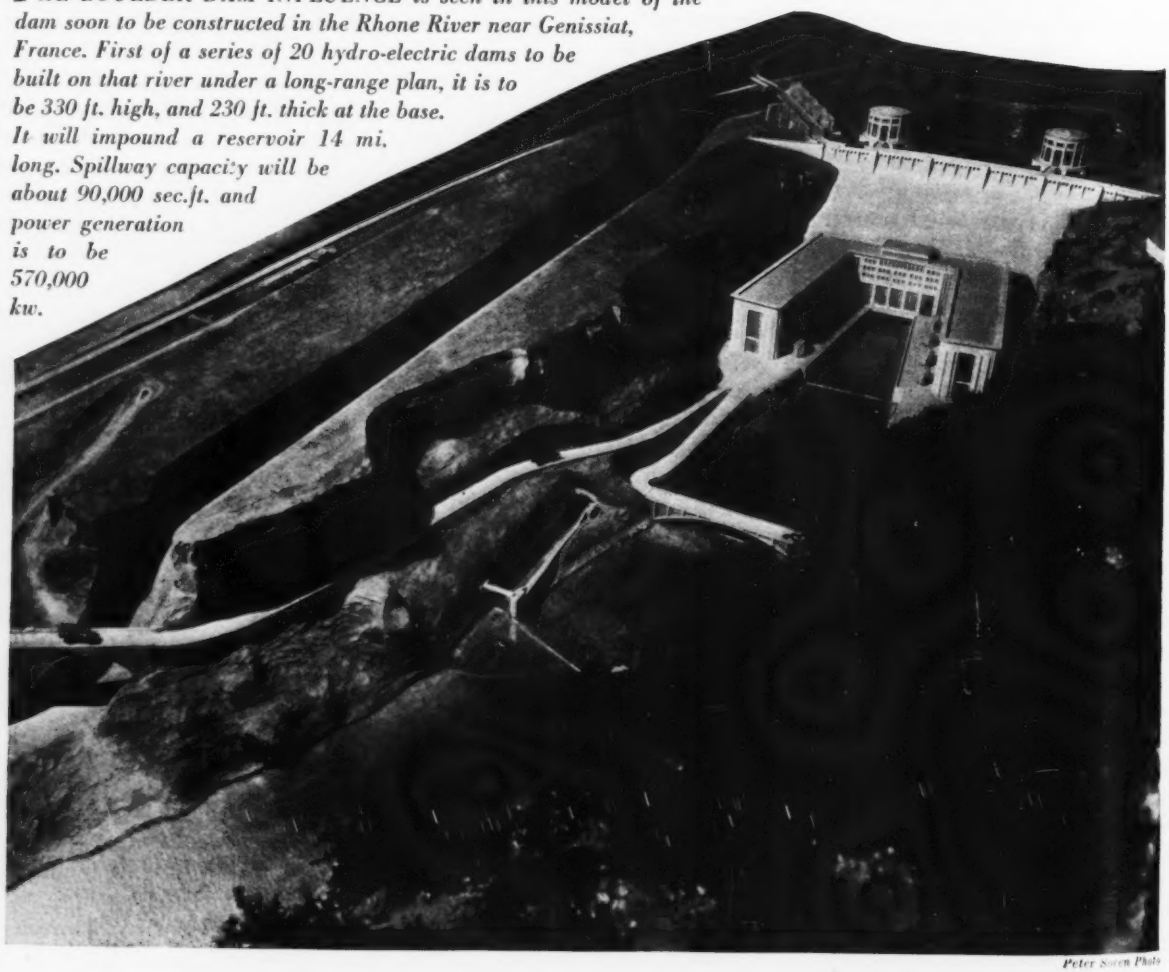
In brief, it is apparent today that business is responding as never before to the stimulating effect of the vast expenditures of public funds that is now getting into full swing. Whether this artificial upswing can be made permanent turns on how quickly American industry can give concrete expression to the lessons learned in past efforts to revive business through public construction.

PICTURES IN THE NEWS

ENR Staff Photo

SAFETY ISLANDS added to Route 29 in New Jersey. The former three-lane and four-lane sections are being widened to five lanes with islands built on the surface of the center lane. Curbs of the islands are of precast white cement concrete. Centers are filled with dark gray concrete corrugated on the surface.

THE BOULDER DAM INFLUENCE is seen in this model of the dam soon to be constructed in the Rhone River near Genissiat, France. First of a series of 20 hydro-electric dams to be built on that river under a long-range plan, it is to be 330 ft. high, and 230 ft. thick at the base. It will impound a reservoir 14 mi. long. Spillway capacity will be about 90,000 sec.ft. and power generation is to be 570,000 kw.



Peter Stern Photo

FIG. 1. A TYPICAL SPRINKLER LAYOUT USED TO WET DOWN THE BORROW AREA PRIOR TO EXCAVATION

Equipment for Processing Fill Material

CARL H. KADIE

Assistant Engineer, U. S. Bureau of Reclamation, Boca Dam, Boca, Calif.

Rolled fill contractors on the All-American Canal works develop moisture regulation at borrow pits and equipment for removing oversize stones

REMOVAL of oversize stone from the pit material was an interesting equipment problem in placing the great volume of rolled fill for the All-American Canal works. These works, including Imperial Dam and the desilting basins at the dam, have been extensively described in *Engineering News-Record* since the general project was outlined in the issue of Oct. 18, 1934. The rolled earth fill work brought several developments of equipment, two of which are the pit sprinkling system and the stone pickers, illustrated and described here. In another article a special development in sheepsfoot rollers will be described.

Getting the picture

The All-American Canal System includes 3,000,000 cu. yd. of rolled-fill earth sections. About half of this rolled fill is at Imperial Dam, forming the California and the Arizona desilting basins and the foundations for various structures, including foundations for parts of the dam. About 1,500,000 cu.yd. of rolled-fill earth sections have been constructed as parts of the canal proper. With two exceptions all of the rolled-fill earthwork has been located along the first 23 mi. of the canal in the form of a levee and in 48 lining sections.

Because of the widely scattered operations, 14 borrow pits were used. After preliminary prospecting, each area was thoroughly investigated by Proctor tests to determine the extent of suitable material, both in area and in depth. In addition to the regular density-moisture, resistance to penetration, percolation and settlement tests, soluble solids and particle size distribution were determined.

As far as the present subject is concerned the specifications required "that all rock larger than 5 in. be removed prior to rolling and that the material should contain its optimum moisture content uniformly distributed prior to rolling." The last two specifications required that this content, as nearly as practicable, be obtained by adding water to the borrow area prior to excavation.

Pit sprinkling successful

Fig. 1 is a typical pit sprinkling system as installed at the borrow pit for the Imperial Dam and the adjacent desilting basins. At the dam George W. Condon Co. (subcontractor under Utah Construction Co., Winston Bros. Co. and Morrison-Knudson Co.) first excavated the materials dry, hauled them to the fill in bottom-dump trucks, spread them by bulldozers, and then added moisture from water trucks. A heavy tandem disk-harrow was used to mix the water uniformly throughout the lift. An unusual amount of disking and other working of the fill was required to secure the predetermined optimum

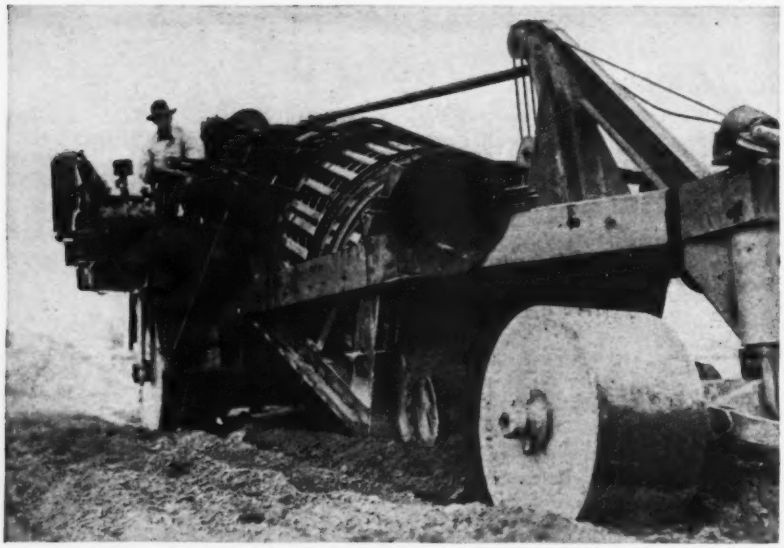


Fig. 2. Tractor-drawn mechanical rock picker at the All-American Canal desilting works. The revolving trommel is lowered so that the apron picks up the top lift. A spiralled blade moves the material through the trommel, the 5 in. rock passes back to a 4 cu. yd. hinged hopper mounted at the back.

moisture content throughout the lift. The water, instead of penetrating, frequently formed a mulch on the surface.

The contractor decided to apply water at the site of excavation by means of a sprinkler system, and jetting where necessary to secure penetration. Fig. 1 is a layout of this sprinkling system. Where the original surface of the borrow area was sloped, a system of ponds was formed by running a road patrol machine in one direction and then perpendicular to that direction. The dikes were completed by closing the corners by hand. As long as these dikes were not very thick, uniform penetration of moisture was secured. From May, 1936, this system was used to the complete satisfaction of the contractor and the Bureau of Reclamation. A much more uniform distribution of moisture was secured and when additional moisture was required no difficulty was experienced in getting it to penetrate the already moist soil on the fill. After using the sprinkling system for some time, the contractor reported considerable saving realized by decreasing the work required on the fill and an indeterminate amount was saved by working all of the equipment in a dustless borrow pit.

Fig. 3. Rock rake used for short period to remove oversize material from fill. The angle of the bed was controlled from the tractor drawing the rake. The bars were set to allow acceptable fines to pass. Oversize was disposed of by opening the gates at the rear of the bed.

Fig. 4. To remove oversize rock after it arrived on the fill most of a bulldozer blade was replaced with bars having openings of slightly less than 5 in.

The stone pickers used by various contractors are shown by Figs. 2 to 4. Another device was a shovel loading into the hopper of a screening plant. This plant replaced the rock rake on the levee section of the canal (Fig. 3). A belt moved the material from the hopper to a vibrating screen. The oversize material was chuted over while acceptable material dropped through the screen into the truck. The plant was mounted on

small wheels and was moved at the convenience of the shovel by a small tractor.

As stated, the removal of material larger than 5 in. from the fill was required in all of the specifications. At times as many as 14 laborers, a foreman and truck were required to meet this provision at Imperial Dam. To cut down this expense, a mechanical rock picker was developed which did the work more thoroughly and gave a greater uniformity by mixing the materials as they were lifted from the fill to the revolving trommel. This action resulted in a perceptible increase in the density of the fill. Fig. 2 shows the rock picker in operation on the fill. Fig. 3 shows the rock rake used on one of the canal levee sections by the Lewis Construction Co., subcontractors. Because of mechanical difficulties this was not particularly satisfactory and was replaced by the screening plant as previously noted. Fig. 4 shows the rock picker used on canal lining by the A. S. Vinell Co.

The All-American canal is under the direction of the Bureau of Reclamation, John C. Page, commissioner, Washington, D. C., and R. F. Walter, chief engineer, Denver, Colo.

Clearing Lands for Reservoirs

Methods for removal of brush and trees and estimates of costs given by army engineer

DEVELOPMENT of effective and economical methods for clearing land that is to be flooded is becoming important in view of the increasing number of projects in which such work is involved. For this reason experience of the army engineers, as outlined by Capt. Keith R. Barney in the *Military Engineer*, should be of value to many contractors and engineers. The subject is discussed in general in Capt. Barney's article, but details that are given relate to work done in connection with canalizing the Upper Mississippi River.

How far above the water surface the site should be cleared depends upon such variables as steepness of slope, depth of root systems, proximity to navigable channels, new groundwater elevation and tolerance of growth to water's edge. Some species of timber may be left close to the water's edge, but generally the steeper the bank, the higher must be the limit of clearing, since the more direct is the attack of water on the roots. On steep banks and where erosion is severe, both vertical and horizontal limits must be fixed to provide for sloughing of the softened soil.

On the Upper Mississippi River work, it was the practice to send in plane-table survey parties, using Topographical Survey prints as work sheets. These parties marked the edge or limit by blazing trees that were not to be cleared, located any high spots within the area, and classified the clearing as to density of growth. This operation cost about 60¢ per acre, inclusive of office expenses.

Estimating the cost of clearing is difficult, and a prospective contractor should know the acreage of timber and brush, classified as follows: (a) heavy timber, (b) brush and widely scattered trees, (c) generally clear. Capt. Barney considers that brush can be cleared at about $10 per acre, and timber at $50 to $100, or even higher. Trees felled by natural causes may be expensive to dispose of.

Some engineers consider the winter as the best time for the work, while others prefer the summer. The latter is preferred by the author, except where timber of good salvage value can be got out through improved access over the ice.

In clearing, the accepted procedure is go through the area twice. First cutting and burning brush, saplings and trees less than 3 in. in diameter, and second, for felling and disposing of the larger timber. Brush crews consist usually of a foreman with 20 to 30 men, equipped with 2½-lb. single-bit axes and a few pitchforks. This crew advances on a front of 300 to 900 ft., piling and burning the stuff at once. For the timber work, experienced woodsmen are necessary. On the Upper Mississippi, the crew consisted of a foreman, 4 felling sawyers (two teams), 2 trimmers or axemen, 4 brush pilers, 6 buckers-up (three saw teams), 5 hand deckers, and 2 burners, or 24 in all. Hand tools included double-bit axes, rakes, shovels and all kinds of saws.

Equipment for piling or "decking" the timber for burning ranges from horses to large tractors for hauling, and from horse-operated A-frames to ½-yd. cranes for piling. "Side-winder" tractors of 30-H.P., with side winches and booms, have been found useful, and in most cases a contractor is likely to encounter timber of such diameter as to need a crane for decking it.

Timber or decking crews work on a broad front. As soon as trees are down, small branches are trimmed off and burned. Larger branches and the trunks are cut into convenient lengths; 12 to 14 ft. lengths are generally preferred, but 14 ft. is excessive for timber more than 18 in. in diameter.

The next operation is disposal, and Capt. Barney says "it is here that the contractor makes or loses his money." He may pile and burn the material, or convert it into lumber or firewood. Hand carrying and skidding by horses, tractors or winches may be employed for piling. Power skidding is done usually on the ground, but may be handled by aerial cables. Hand hauling is limited to a distance of a few feet, or where not more than four men are required. A pair of horses or a team of four horses is generally more satisfactory, but where timber is too heavy a tractor or winch must be used. For economical work the timber must be well concentrated, as long tractor haul or frequent moving of winches will eat up expected profits.

For piling the timber, A-frames, side-drum tractors or cranes may be used, depending upon the heaviness of the timber. It may be piled first and then burned, or the fire may be started and timber piled on as it

burns. The former is safer, and gives freedom from smoke and heat during operations. But the latter, or "hot decking," has the advantage of tending to pack the timber more tightly, with more completely burning and less clean-up work. A high-line cableway, strung between trees, presents several advantages, but these are balanced by difficulties of operation.

Best burning conditions

Piles may range from a few cubic feet to 2,000 cords, but it is necessary to avoid the dangers of too many fires.

Burning is done most effectively when the wind is brisk and is blowing lengthwise of the pile. Since rain may stop the burning for a few days and snow may stop it till the next summer, the piling and burning should follow the felling as closely as possible. Men must be kept at hand to make sure that the fires continue to burn, and to roll into the fire any stray logs and butts of burned logs.

For salvaging timber, easy accessibility is essential. If cost of transportation is considerable the wood is not worth the trouble of moving. Whether the salvaging is done by the contractor or by others under agreement with him, the logs must be marked so that they will not be burned. Sawmills for cutting lumber must be located near a good road. For safety, private parties engaged in salvaging must be kept well away from the tree felling operations. It is estimated that every 1½-ton truck load removed by private parties saves the contractors about $2 in disposal costs. Salvaging also improves public relations, as the general public is apt to regard burning of timber as wanton destruction of the natural resources.

Cleanup operations

Cleanup operations consist in final removal of small branches and incidental debris, usually by raking. The engineers must see that the contractor keeps within his prescribed limits, and that he conducts the work in orderly and complete manner, as otherwise it will be difficult to make estimates for partial payments. Where the contractor's superintendents are lumber men, stronger on cutting trees than on decking and burning, the resident engineer will have to apply constant pressure to keep the burning near the felling operations. He may also have to prod the contractor as to the progress of the work, as such contracts seem to be generally on a tight schedule for completion within the specified time. Then, too, there must not be a long interval between the clearing and the flooding of the land, or another crop of brush will grow.

In many ways this sort of work is well suited to the force-account system with hired labor. Differences of hired labor operations as compared with contract operations are almost entirely in the matter of labor relations. As labor costs represent at least 75 per cent of total cost, it is important that the labor be effectively employed, but, as the author explains, "it is difficult to get either foremen or laborers to work as efficiently for the government as they would for a private contractor." Clearing is an intangible task that is attractive to entirely inexperienced bidders.

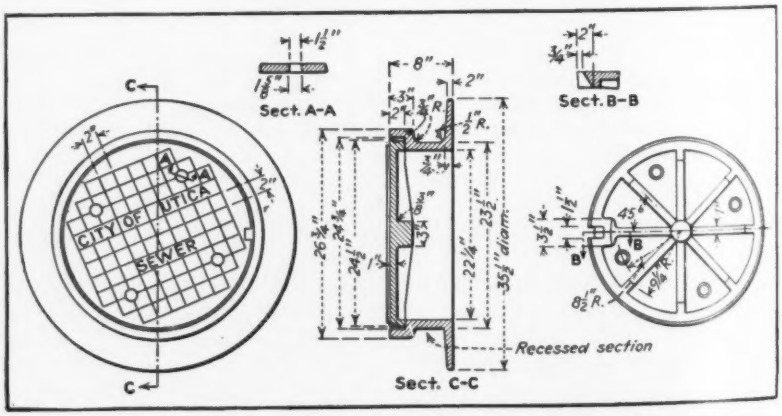
Locking A Manhole Frame To Pavement Foundation

A MANHOLE FRAME designed to prevent the heaving or separation of the pavement from the frame has been adopted by Utica, N. Y. Its principal feature is a recessed section around the circumference of the frame into which the foundation material can pack and thus lock the frame integrally with the balance of the pavement. Should any movement occur, the frame and pavement must move as a unit and cannot become separated.

It is expected that this design will eliminate the depressions frequently found around manholes and otherwise smoothly paved streets. In most cases these depressions are caused by slight upheaval of the pavement which moves away from the manhole frame. To discourage transverse cracking at manhole locations, steel reenforcement is placed in the base to compensate for the lost sectional area in the concrete.

Details of the cast iron frame and cover are shown below. The frame has an overall base diameter of 35½ in. and it is 8 in. high. The recessed section, which begins 3 in. from the top of the frame, is 4½ in. in width and 3¼ in. in depth. The cover is 24½ in. in diameter and weighs 150 lb; the frame itself weighs 215 lb. By machining the contact faces of both frame and cover to insure a close fit, rattling of the cover is minimized.

The design was developed by the city engineering department which is under the direction of Joseph P. Shaw. Guy C. DeWitt is city paving engineer.



Recessed manhole frame which is "locked" into the pavement foundation and thus eliminates heaving or separation.

FIG. 1. SAND COUNTRY AND A SAND-ASPHALT ROAD IN NORTH CAROLINA

Earth Roads in the South—VI

C. S. HILL
Associate Editor, *Engineering News-Record*

North Carolina

North Carolina with a complex secondary road problem is setting a fast pace in developing ways of using its vast areas of sand for road construction

NORTH CAROLINA, as most road engineers who date back a couple of decades can recall, was the first state in the South to plunge extensively into high-type road construction. Then afterwards it was the first state to place all highways under control of the state highway department. The two acts have been fruitful in present problems. One of these is the use of earth for constructing low-cost roads; it is being effectively attacked by processing local soils with tar, asphalt and cement, and this is our principal concern here.

The processed or stabilized soil road became a really formidable problem in 1931. That year the state legislature transferred 45,092 mi. of county roads to the state; the state already had 9,099 mi. of primary road to care for and the county-road addition increased the state system to 54,191 mi. Since 1931 additions have been made to both primary and county roads until the total is now 58,212 mi. About 4,625 mi. of these roads are high-type construction; the remainder are secondary-type or poorer construction.

Two problems faced

Of the high-type roads some 2,600 mi. are more than ten years old and, pounded by the heavy trucks and high automobile speeds of today, they are in need of reconstruction. Sand asphalt, which is outstanding among materials being used for secondary construction, is the major material employed for building up the new high-type section from an old concrete road. This is the first problem.

The second and major problem is the secondary-type road where a combination of construction and maintenance processes is used. On the lesser improved roads maintenance is keeping the roads travelable and building them up to standards of higher improvement. Construction is then taking the roads over for more permanent improvement.

North Carolina like South Carolina is going extensively into soil processing. Like other states it uses the natural stable soils without processing but such soils are not too plentiful. To meet the situation the state highway engineers turned in 1935 to a well provided soils laboratory. Out of this laboratory and coordinated experimentation in the field in which L. D. Hicks, materials engineer, and C. T. Carmichael, chemical testing engineer, have wrought mightily in developing mixes and processes, are coming the current practices in soil processing and natural stabilization.

In two of these practices North Carolina shows advances that set it apart in recent developments of earth roads in the South. These are: sand-bituminous bases and traveling-

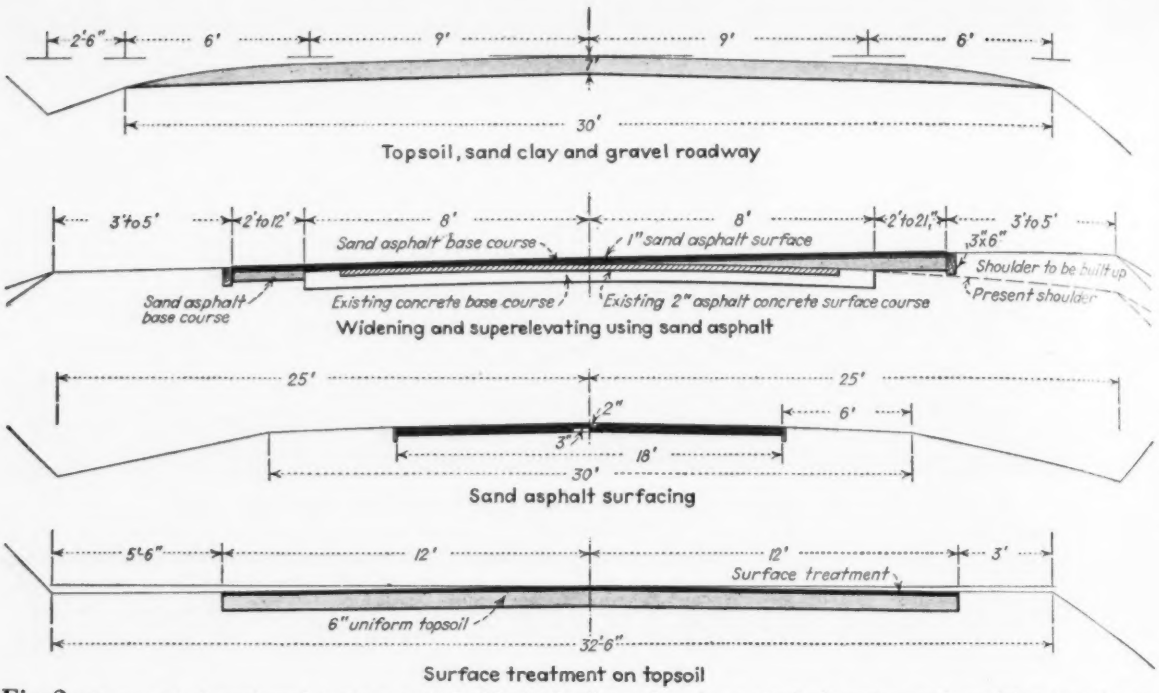


Fig. 2. Some typical earth-road sections used in North Carolina; there is no standard section, each road has its individual design to cope with local conditions.

plant-produced sand-asphalt surfaces, and attention is centered on them.

The combining of sand and tar or asphalt for roadbuilding by North Carolina engineers has been developed for base-course construction, which presumes later surface treatment, and for full depth road or traveling plant-mix surfacing. The large part that the two practices play in the highway economy of the state is indicated by the fact that 46 per cent of its area containing about 19,000 mi. of earth roads is coastal plain or sand-hill country where sand is about the only roadbuilding material.

The bituminous bases

The main types of base courses are: Tar-stabilized soil bases; sand-asphalt bases and sand-asphalt bases with enriched top. In general principles, tar processed base construction conforms closely to that practiced in South Carolina and described in the article on that state. Essentially, the moisture content of the soil is adjusted to take up the tar readily and then the liquid content of the soil-tar mixture is adjusted to insure ready compaction. Mixing and compacting are about the same processes as in South Carolina and as in that state insistence is put on adequate equipment. As specified the minimum requirement is: One pressure distributor, a pull-type 12-ft. blade grader; a rubber-tired 10-ft. blade motor grader; a harrow with 22-in. or larger disks; a scarifier or plow; a sheepsfoot roller 100 lb. per sq.in.; a pneumatic tired rolled; ample water tanks and enough tractors to operate the pull-type equipment.

Sand-asphalt base construction is a road-mix operation much the same, except in one particular, for both normal base and base with enriched top. Analysis of the sand sets the amount of asphalt, which ordinarily runs from 0.6 to 1 gal. per inch depth of base. If the roadbed sand is suitable it is used, otherwise it is adjusted or replaced by sand brought in from selected sources. Generally not more than 5 per cent of clay is allowed. The asphalt is a naphtha cutback with a base penetration of about 90.

Construction of sand-asphalt base can not be fitted to formula; both the number and the length of the mixing and compacting operations depend on the immediate conditions and must be decided by the engineer. In mixing the requirement is a uniformly homogeneous mixture, in compaction it is an evenly solid and dense slab and the engineer must decide when both requirements are met. Certain controls can however be laid down and in North Carolina practice they are as follows:

Subgrade has to be to exact profile, uniformly compacted and adequately drained. No base can be laid on muddy subgrade or on sun-baked top crust until it is scarified. No asphalt can be applied between Oct. 31 and April 1 or at other times when the air temperature is less than 50 deg., and when applied it may not be cooler than 90 deg. nor hotter than 130 deg. A pressure distributor (15 to 50 lb. per sq. in. pressure) is required and application is in instalments of ½ gal. per sq.yd. The mixing proceeds with each oil application and thereafter until evaporation of the naptha is enough to have "fixed" the mix. This is the normal base operation; for enriched top another dose of asphalt is applied and the top 1 in. or so is remixed. The equipment for mixing is about the same as that previously named for tar-processed base but the base is compacted with a 6- to 8-ton tandem roller.

The distinctive sand-asphalt work in North Carolina is its two course surfacing of plant-mixed material and for information about this, T. V. Fahnestock, bituminous engineer for the highway department, proved a

rich source. Only two types of operation are described here. As told by Mr. Fahnestock, in 1935 and 1936 several projects were let to contract for sand bituminous pavements specifying the use of a rapid-curing cutback asphalt. At the time bids were called for there were no traveling mixing plants in the North Carolina territory and the specifications were prepared with the idea that the pavement would be constructed by mixed-in-place methods using a distributor to apply the asphalt and harrows, blade graders or other similar equipment for mixing. However, the specifications were drawn to permit the use of traveling mixing plants. The low bidder on projects in Duplin County, 10.94 mi. and in Pender County, 3.86 mi. decided to use a traveling mixing plant as shown in Fig. 4.

The construction procedure on these projects was identical and proceeded as follows: After fine grading had been completed sand was hauled in and spread on the prepared subgrade, or where sand occurred in the subgrade the grade was left 1 in. higher than the elevation of the finished pavement as shown on the plans. Sufficient sand to construct the pavement was bladed to a windrow in the center of the road, but it was left spread except for a distance of about 2,000 ft. in front of the mixer as it could be dried out much more rapidly when spread out.

The machine used measured both the aggregate and bitumen by volume, therefore it was necessary to make moisture and bulking tests on the sand prior to setting the speed for the asphalt pump and the opening on the discharge gate of the aggregate hopper. After proper adjustments had been made it was found that the bitumen content varied very little during a day's run, in fact, this variation was no more than in mixes made in plants where the aggregate and bitumen are weighed. The machine mixed enough material for a pavement 20 ft. wide and 5 in. thick, at the rate of about 4 lin. ft. per min., but due to shutdowns while waiting for asphalt or on account of weather conditions it was never able to average this production over a day's run, the longest stretch in a 12-hr. day being about 2,000 ft.

While these projects were under construction frequent rains caused much delay to dry out the sand ahead of the mixer. This finally became such a serious factor that canvas was used to cover the windrow for 2,000 to 3,000 ft. in advance of the mixer and also for a like distance behind to prevent the newly mixed material from absorbing moisture. The mixed material was also made more resistant to wetting from rain by pulling a heavy steel-shod drag made in the form of an inverted U over the windrow directly behind the mixer. This drag helped to glaze the surface of the windrow and cause it to shed water until the weather was suitable.

After mixing, the material was spread with blade graders and harrowed with disk harrows to evaporate

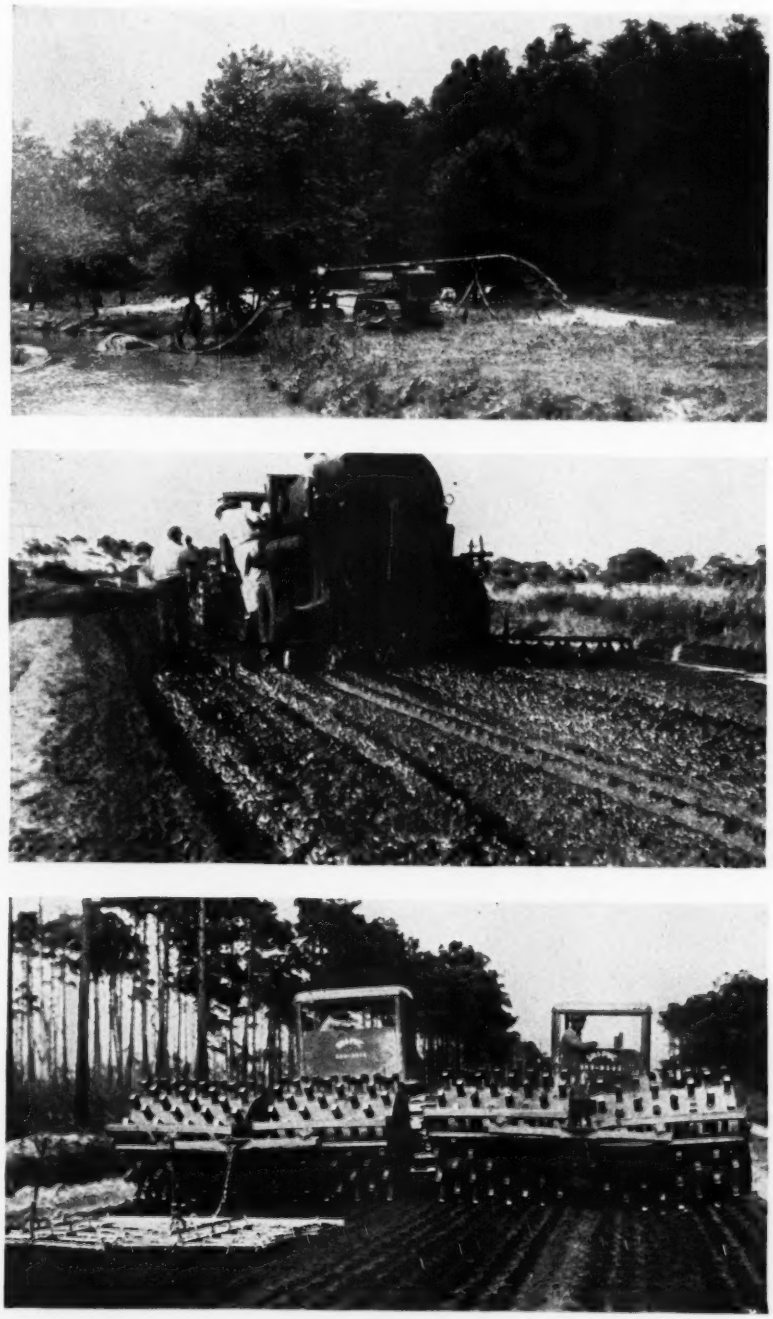


Fig. 3. Equipment dominates construction; at the top a tractor operates a 6-in. centrifugal pump sucking sand from a small stream; in the middle a pressure distributor tars a road base and at the bottom sheepsfoot rollers compact a cement processed soil base

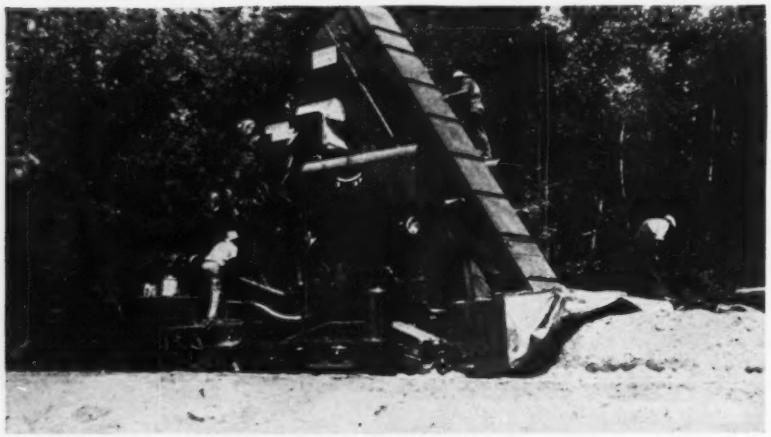


Fig. 4. Traveling plant gathers up sand windrow into a sand hopper which delivers a controlled feed to the mixer where asphalt is applied and which deposits a windrow of mixed sand-asphalt

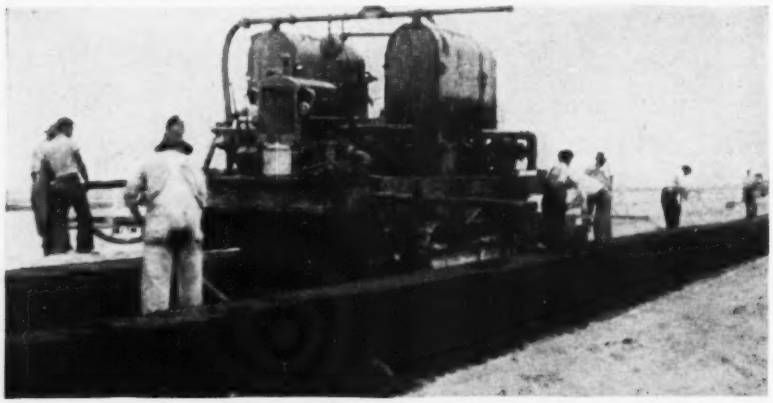


Fig. 5. A traveling plant used on a very wide road on which five parallel windrows of material were required; this machine feeds raw sand directly to the pug mill mixer and control is accomplished by sized raw-sand windrows and speed of travel

Fig. 6. A tractor-hauled carryall scraper sloping the bank as it makes a cut in grading a North Carolina road

the solvent and moisture. Sand having up to 8 per cent moisture at the time of mixing was used without difficulty other than additional manipulation after mixing to dry it out. The specifications on these two projects called for top 1 in. of the pavement to have a greater bitumen content than the lower 4 in., this enriched top to serve as a wearing surface. The enrichment was done after the mix from the machine had been dried out and spread, by loosening the top inch with a disk harrow and applying the necessary amount of cutback asphalt with a distributor; this was mixed with blade graders, spread and rolled to complete the pavement.

The grading of the sand used varied widely and it was necessary to make changes in the bitumen content accordingly, the average in the base being 4.1 per cent and in the enriched top, 6 per cent.

On two projects, constructed in 1937, the plant shown by Fig. 5 was used. This machine does not have an aggregate bin but propels the sand directly from the road to the pug mill mixer by blades and spiral gathering screws. The bitumen content of the pavement depends on three factors: the size of the windrow of sand in front of the machine, the forward speed of the mixer and the speed of the asphalt pump. Tachometers are provided to indicate the pump speed and the forward speed of the machine. The size of the windrow of sand can be controlled by using a strike-off board across the front of the gathering blades. This strike-off board is fastened to the blades at the proper height to permit the desired volume of sand to be fed to the pug mill.

The pavement on the first project is 46 ft. wide and 5 in. thick. The sand was very clean, only 1 per cent passing the 200 mesh sieve, and due to this the bitumen content was kept to an average of 4 per cent. The pavement was constructed by mixing in 5 windrows following which the mix was spread and aerated with harrows and blades and rolled.

On the second project the pavement is 18 ft. wide and 3 in. thick and the mixer was able to mix all of the material in one windrow. This quantity however taxed the capacity of the mixer and it was necessary to place reduction sprockets on the machine to provide more power by reducing its speed before satisfactory results was obtained.

In North Carolina, W. Vance Baise is state highway engineer and his cooperation was complete in providing the information of which this article is but a brief record.

Iron Inner Tube Strengthens Conduit

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Division of Water, Department of Public Service, Toledo, Ohio

Construction methods used in lining Toledo's sole supply conduit without interrupting normal water service

HOW TO STRENGTHEN a section of 72-in concrete water conduit without interrupting service was the unusual problem confronting the Toledo water department when the construction of a crossing-elimination project jeopardized this vital part of the distribution system. Sole supply line to the city, the conduit was in close proximity to the proposed grade-crossing subway, construction of which would remove 12 ft. of earth cover considered essential to balance the internal pressure in the conduit. The solution consisted of lining 500 ft. of the conduit with iron plate, work on which could be carried on only by dewatering the line for limited periods during the night.

To fully understand the problems involved in this novel undertaking, it will be helpful to briefly describe the general layout and operation of the city's water supply system. Water is taken from the Maumee River, raised some 65 ft. to pass through the filtration plant, and then flows to a 5 m.g.d. covered reservoir. From this storage reservoir, the water flows by gravity for 2½ miles through a 72-in. concrete conduit to a 16 m.g.d. covered reservoir and from here it is pumped into the distribution system. Both reservoirs ride on the hydraulic gradient of the flow in the conduit, the differential head between the two maintaining flow from the filtration plant to the high service pumping station.

The conduit is of plain concrete construction circular in cross-section, with walls about 10 in. thick. It was built in 1909 and serves as the only connection between the filtration plant and the distribution system. Through most of its length, the conduit lies at an average depth of about 20 ft. It was constructed for the most part in a tunnel, and the circular concrete shell was poured in two parts with the joints along the spring line. Its strength to resist bursting pressure from within depends entirely upon the load imposed by the weight of the earth above.

The conduit passes beneath a Wabash R. R. crossing on one of the principal streets in Toledo. When plans began to materialize in 1935 for the construction of a subway to eliminate this grade crossing, consideration had to be given to protecting the conduit. Investigation showed that the underpass construction would create two points of probable danger. At one point in the proposed roadway, the grade was to be lowered to an elevation which would leave only 8 ft. of cover. At this place the maximum pressure in the conduit was known to be 27 ft., or 12 lb. per sq.in. which, with reduced exterior loading, would have produced a calculated tensile stress of 35 lb. per sq.in. in the concrete conduit.

The other dangerous point was in the vicinity of the proposed center pier footing of the underpass; this was only 3 ft. vertically and 3 ft. horizontally removed from the line of the pipe. Possibility of damage to the footing due to leakage from the conduit and vice versa, damage to the conduit due to excessive loading from the footing were both recognized. Although test borings revealed a very good grade of hard blue clay in this area, this was not sufficient reason for eliminating all anticipation of probable danger.

Original plans called for the construction of a 66-in. by-pass around the underpass, but the bids received for this work were greatly in excess of

Fig. 1. Erecting top liner plates with the aid of a movable car with adjustable uprights at each end.

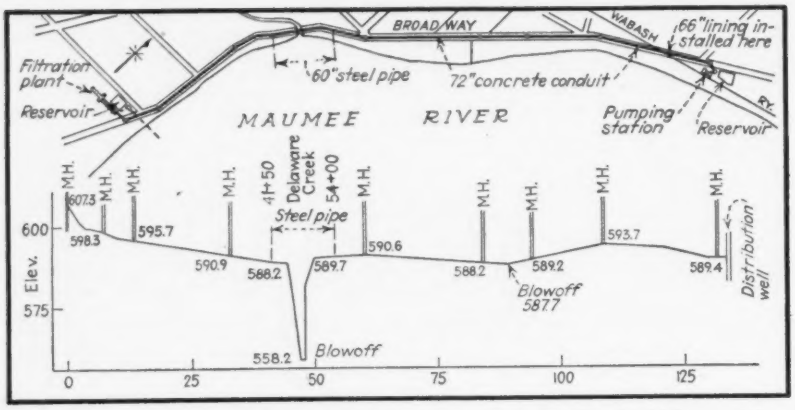

Fig. 2. Plan and profile of the 72 in. concrete conduit, 500 ft. of which was reinforced with an internal iron lining.

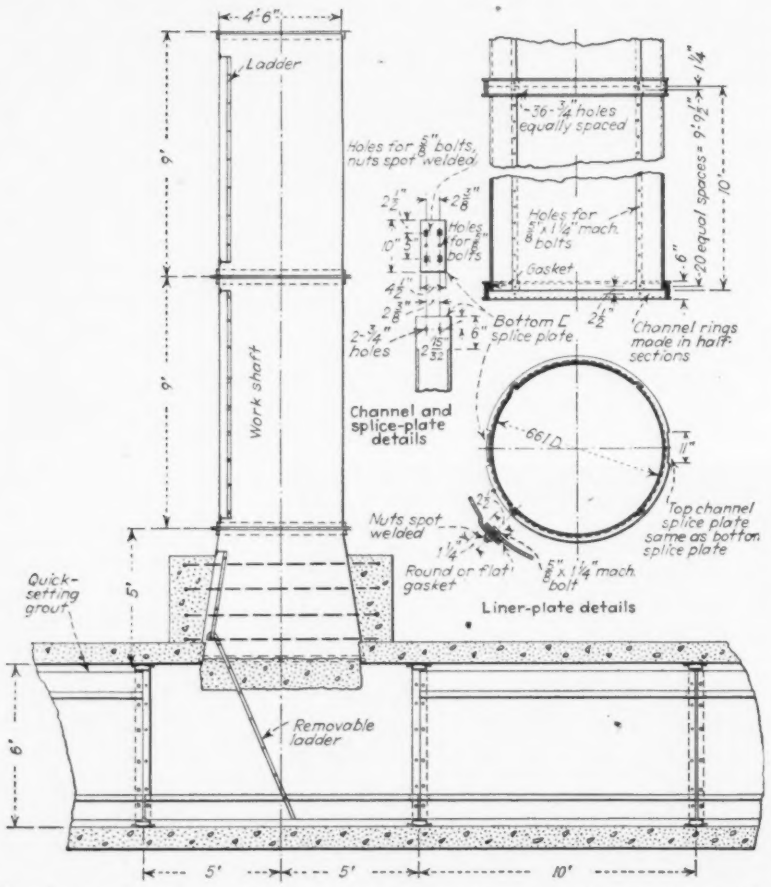

Fig. 3. Details of the workshaft, the liner-plate design, and installation of the shell in the conduit.

both the estimates and the appropriation for the project. A new plan was then evolved, calling for the reinforcement of the old tunnel by lining it for a distance of some 500 ft. with wrought iron plates. This called for the use of No. 8 gage plates, 10 ft. long and one-quarter of the circumference in width, built to an internal diameter of 66 in. Six inch steel channels curved in the shop to fit the outside diameter of this iron plate tube, were used to make up the circumferential joints.

Welded construction was first specified but this was abandoned in favor of an alternate bid calling for bolted and gasketed construction. This called for the spot-welding of nuts on the outside of the channel, and on the underside of the underlapping plate along each of the four longitudinal joints. Bolt holes in the plates were punched at ¾ in. dia. which later proved to be too small for flexibility when using ⅝ in. bolts. Asbestos gaskets were inserted under the edge of each plate at the circumferential joints and between the two plates back of the bolts, along each edge of the longitudinal joints. After the iron shell was erected, the space between it and the concrete conduit was filled with cement grout.

Construction operations were carried on from a workshaft near the center of the 500 ft. section. This shaft consisted of a 42 in. circular steel shell 23 ft. high, with a bottom transition piece passing to a rectangular cross-section fitting snugly against the outside of the conduit. It was designed to permit the turning of each plate through 90 deg. into the alignment of the tunnel after having been lowered endwise down the shaft, Fig. 3). During the period when the top of the conduit was exposed by removal of the earth covering the conduit was kept in use, but with reduced head. This was accomplished by lowering the level of the two reservoirs and keeping the flow from the filters to a minimum.

After the bottom of the workshaft was concreted in place an opening was made in the conduit. A narrow-gage track, built from 2 in. iron pipe, was then laid in the conduit. Special cars were built to fit the tracks, one of which was designed to handle the 10 ft. liner-plates. This car had two vertical folding arms, one at each end, which were used in lifting the top plate into place in final assembly (Fig. 1).

The channels for the lining were brought down first into the tunnel, followed by the bottom plates and these were assembled. The bottom plates were then grouted in place by hand, the grout being handled in a mortar box mounted on a track car. These operations were followed by the installation of the side and top plates thus completing the assembly of the metal shell. Finally the remaining space back of the plates was filled with grout, forcing the grout by air pressure through special holes provided in the center of each of the top plates.

During the early part of the work considerable difficulty was encountered in the assembly of the plates due to slight irregularity in the alignment of the old tunnel, and also to the lack of flexibility in the liner plate design. The latter did not provide sufficiently large holes for the bolts (only $\frac{3}{4}$ in. holes were allowed for the $\frac{5}{8}$ in. bolts) and did not provide adequate clearance between the ends of plates where they were assembled on the circular channels at the circumferential joints. Also during this early period the space in back of the side plates was filled with grout before the top plates were in place and almost invariably this left the bolt holes out of line with no play in the iron shell to permit the plates being pried into place. This difficulty, along with those due to unforeseen allowances in design, necessitated the enlargement of bolt holes and trimming the ends of plates to eliminate overlap at the joints. To facilitate the assembly of the shell during the remainder of the work, all holes in the plates that did not have nuts spot-welded to them were reamed out to $\frac{1}{8}$ in. dia. before the plates were lowered into the tunnel. The pressure grouting was performed as described below.

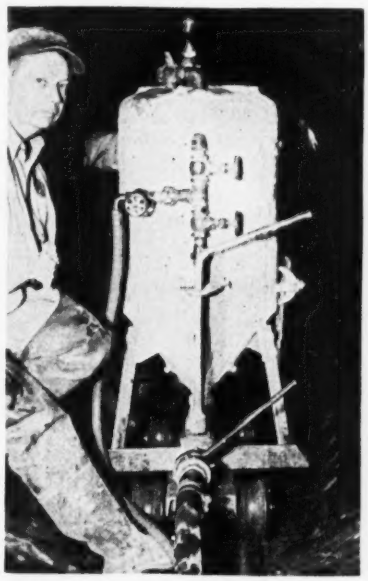

Fig. 4. The grouting machine mounted on a narrow-gage track car.

Fig. 5. Pressure grouting behind the top plate of the lining.

Pressure grouting

Grouting above the bottom plates was accomplished by the use of an air pressure machine mounted on wheels to run on the track in the conduit (Fig. 4). A pressure of about 50 lb. per sq.in. supplied by an air-compressor above ground, was applied to the chamber of the machine. The machine had a capacity of about 4 cu.ft. of grout and it was possible to handle from 12 to 16 batches per hour.

It was necessary to do the grouting by hand, in three stages, subsequent to the grouting under the bottom plates. The first operation brought the grout up to the top of the side plates and the second to the level of the top plates. During these operations an ell-shaped nozzle was used on the end of the discharge hose and this was inserted loosely into the top holes and pointed to the side for which the grout was intended.

For the topmost and final grouting 2 in. radiator valves were connected to each of the threaded holes and the hose from the grouting machine coupled to it with a fire hose coupling (Fig. 5). After this grout had filled the space directly about each valve, the valve was closed and the hose connection moved ahead to the next section. It was necessary, during this operation, to start at one end of the tunnel and fill each section consecutively, thus forcing all air and entrapped water ahead and out the far end.

However, even this precaution did not prevent the buckling of the top plate at three places during this final grouting. It so happened that two circumferential channel joints with very limited openings above them had been accidentally filled during the previous groutings and these invisible obstructions caused a transfer of air pressure in the machine to a combined air and hydraulic pressure in back of the plates as the grout was forced into the last section adjacent to these obstructions.

The use of a rich grout, 1:1½ min., using high-early-strength cement, greatly facilitated the work by permitting the grouting to continue within 30 min. of the time when it was necessary to fill the conduit for water service. To further accelerate rapid setting of the initial grout under the bottom plates an admixture of alumina cement was used. One sack of this cement was added to the grout in the large batch box in the tunnel and thoroughly mixed with the regular grout by hand immediately before placing. By this method setting was obtained in from ten to fifteen minutes. The alumina-cement content amounted to about 20 per cent of the cement in the grout.

Upon completion of the work of lining and grouting in the tunnel, all equipment was removed from the shaft and the final top plate at the bottom of the workshaft, was lowered and bolted in place, closing the entrance to the conduit. The hole that had been cut in the top of the conduit was then refilled, sealing the tunnel permanently.

Limited working periods

As mentioned heretofore, perhaps the most unusual element in the execution of this project was that of the restrictions imposed upon the frequency and length of working periods. This conduit has been the sole channel of supply from the filtration plant to the distribution system for 26 years, and it had been emptied only a very few times during this period of service. The construction program for the lining installation called for at least twenty shutdowns and much study was given to the difficulties that might be encountered and to the proper routine for emptying and refilling the conduit.

The operating procedure during shutdowns of the conduit was as follows: As soon as the pumpage into the distribution system at the pumping station had dropped to about 32 m.g.d. during the evening, the filtra-

tion plant was shut down completely. This necessitated first of all the closing of the 30-in. valve on the line connecting the reservoir to the conduit, then stopping all pumps in the low service station and finally closing the effluent valves on all filters then in operation.

At the pumping station the large 30-m.g.d. triple expansion pump, which is normally in operation was stopped. In its place a 30-m.g.d. turbine-driven centrifugal pump, was put into operation. This changeover made it possible to utilize a 42-in. blow-off through the shutdown pump direct to the river, which had originally been a suction connection from an old intake in the river. Valves were then operated to isolate the pumping station, the lower reservoir and the distribution system from the filtration plant and the 72-in. conduit. Water for pumpage to the distribution system was drawn through an auxiliary 42-in. connection from the lower reservoir, thus making it possible to empty the conduit and the distribution well.

During shutdown periods, discharge pressure into the distribution system was lowered from the normal pressure of 75 to 60 lb. per sq.in. This reduced the demand on the lower storage reservoir and consequently lengthened the time available for construction in the conduit. Along the route of the conduit, two 12-in. blow-offs were opened to aid in draining. Manhole covers were opened to prevent air-binding during the emptying and refilling periods.

The procedure in refilling the conduit and putting the system back into operation was in general just the opposite of the emptying procedure. However, it required careful manipulation to fill this two and one-half mile, 6-ft. diam. tunnel without setting up destructive surge waves. To minimize this potential danger the 42-in. blow-off connection at the pumping station was kept partly open until the water in the distribution well was level with the water in the reservoir.

During refilling, after the first three or four shutdowns, it was noted that the flow in the conduit did not come back to normal until 7 or 8 hours had elapsed. It was later found that a cover on a manhole about 700 ft. from the filtration plant had not been removed and an airpocket had formed. This condition caused a reduction in the effective area of the cross-sectional area in such a way as to slow up complete filling of the conduit. The trouble was remedied by placing an open grating over the opening while the conduit was empty or refilling.

This project was undertaken and completed under the supervision of George N. Schoonmaker director of public service and now chief waterworks engineer, Robert W. Furman, commissioner of water, and William G. Clark, consulting engineer for the Division of Water. Construction work was under the supervision of Ralph Reed, deputy water commissioner, assisted by the author.

Bridge Curbs and Rails

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Some examples of bad practice and a few rules of good design based on highway guard rail research

ON THE FACING PAGE are eight pictures of bridge rails and curbs all of designs commonly seen and all in some respect faulty in design. What then is a good curb and rail? Let us see what facts we have to go by. Facts are badly needed for to a great extent rail design has been used as an outlet for the individual taste of the designer, rather than to provide a serviceable part of the bridge, particularly when there was a consulting architect.

Extensive tests on highway guard rail have indicated certain general principles of designs that also apply to bridge curbs and rails. The tests showed: (1) That the rail should deflect and guide rather than stop the vehicle; (2) a smooth surface on the rail is very desirable; (3) the rail should be offset in front of the posts, or otherwise placed so that a vehicle sliding along the rail will not strike the posts; (4) posts should not project above the rail any further than is necessary, as fenders of cars and bodies of trucks project over the rail and strike the tops of the posts as the vehicle glides along the front of the rail; (5) the adjoining sections of the rail should be so connected that they will act together under the impact of a vehicle; this requires longitudinal strength in the rail elements and end connections; (6) adequate end anchorage is very necessary.

The wheel spindles and axles of practically all cars and trucks are

Fig. 1. An excellent type of curb and rail but the rail is not set back from the curb far enough and the rails do not have good end anchorage.

from 12 to 18 in. above the surface of the roadway. A curb from 14 to 18 in. high then will be very effective in checking all cars and further provides a smooth surface. Curbs 14 in. high have been used on bridges in Georgia for about seven or eight years and thus far there is no record of a car or truck passing over the curb on any of these bridges. The overhanging bodies have damaged the rail in a number of cases but this trouble could have been greatly reduced if the rail had been set 12 in. or more back from the curb line.

The present design practice in bridge rail is usually a horizontal beam, or beams, with occasionally some cantilever support from the pickets. A bridge rail with adequate

CURBS AND RAILS

Fig. 2. A model-T struck this post and one of the top rails fell, prying the top off the second intermediate post.

Fig. 3. A common type of rail that affords little protection; the wheels can readily mount the curb and the rails are not secured to the posts.

Fig. 4. A 14-in. curb and single bar rail; wheels cannot mount the curb but the rail is too close to curb and the posts project in front of rail.

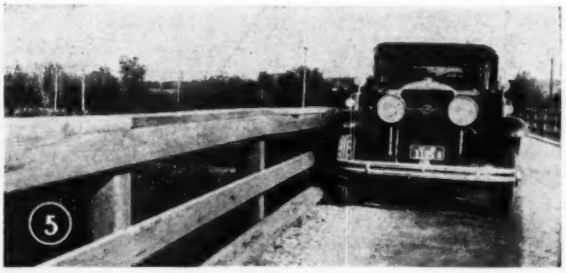

Fig. 5. A commonly-used type of wood "hand rail" which affords almost no protection to motor vehicle traffic.

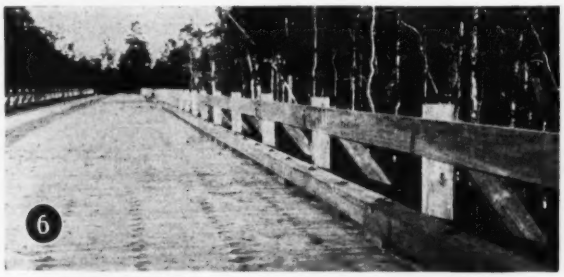

Fig. 6. An excellent wood rail and curb; the curb is 12 in. high but the rail is not fastened securely enough to the intermediate posts.

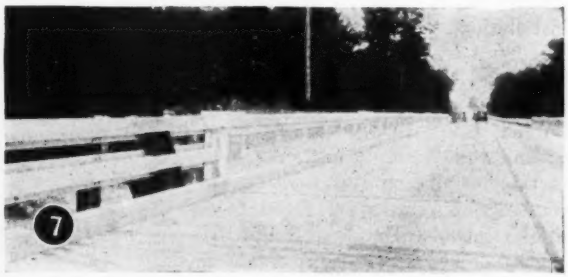

Fig. 7. A heavy steel rail with smooth surface but note the very weak end and intermediate connections; the curb on this bridge is only 7 in. high.

Fig. 8. Old style steel "hand rail," veteran of many impacts, affords little protection.

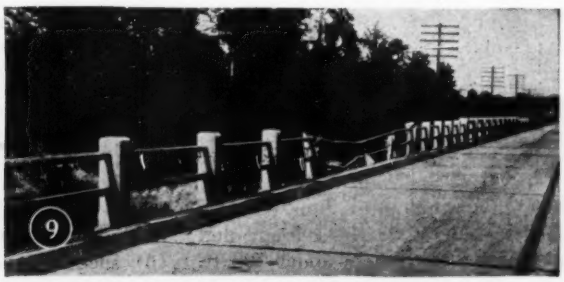

Fig. 9. The car went over with fatal results; the rail had been propped back up when the photo was taken.

longitudinal strength and proper end anchorage affords much better protection than the beam types of rails so commonly used. To meet this suggestion it would not be necessary to modify greatly many designs in use at present. The main changes necessary are to provide longitudinal strength and end anchorage for the rails.

Sufficient beam strength is needed to maintain alignment and withstand minor accidents without undue damage. Designs for a horizontal force of 300 lb. per lin. ft. should be sufficient for this. A usual guard rail strength specification is an ultimate longitudinal strength of rail element and connections of 90,000 lb. To fit with practice in bridge design a required longitudinal strength in rail and connections of 30,000 lb. would correspond. The end post, or end anchorage, supporting the rail should be designed to withstand a pull of this amount. If the guard rail analogy is carried on, the intermediate posts should be designed for a horizontal force of 5,000 to 6,000 lb.

These requirements in bridge rail design will not materially increase the cost, but if we can rely on the guard rail tests as a comparison (which is the only pertinent information available) they will greatly increase the safety of the bridge rail.

To summarize: (1) A substantial curb at least 12 in. high. (2) A rail with a smooth surface on the traffic side set at least 12 in. back of the curb line. (3) Where pedestrians are not involved the rail should be from 20 to 27 in. high. (4) The rail and end posts should be designed for a longitudinal force of 30,000 lb. (5) End posts should be provided wherever the continuity of the rail is interrupted, at the ends of spans, expansion joints, etc. (6) The intermediate posts, or supports, should be designed for a horizontal force of 6,000 lb. acting in any direction and should be spaced not more than 12 ft. apart.

Highway Lighting Experiment

First two open road lighting projects in California located near San Francisco

AN EXPERIMENT with highway lighting as a means of reducing night accidents on the California state highway system has begun with completion of sodium vapor lamp installations put in recently on two lengths of U. S. Route 101 near San Francisco. The first of these extends 1½ mi. from the north end of the Golden Gate Bridge to a point beyond the Waldo tunnel. As soon as this installation was finished the construction crew was moved to a similar job starting where Route 101 crosses San Francisco's southern boundary and extending thence 3½ mi. southward. Both installations are equipped with sodium vapor lamps which have a rating of 10,000-lumens.

Lighting the north approach to the Golden Gate Bridge was the more urgent because this district is subjected to frequent fogs; the bridge and the nearby tunnel are well lighted and thus traffic often passes from a brightly lighted roadway into dense, dark fog in which headlights are not effective.

Two types of lighting standards are used, (1) tapered steel and (2) centrifugally spun concrete. The poles are 30 ft. long and are set on a concrete base extending 5 ft. into the ground. A removable arm suspends the luminaire 2 ft. inside the edge of the pavement at a height of 26 ft. On the bridge approach the spacing varies from 150 ft., staggered, south of the tunnel to 215 ft.

Fig. 1. New highway lighting standards on north approach to the Golden Gate Bridge.

north of the tunnel, where lights are placed only on the outside of curves. South of the city the spacing is 140 ft., staggered, throughout.

These two locations were selected for first attention in a lighting program because of particularly high night-accident rates; they are regarded as a proving ground for the efficiency and cost of open highway lighting.

Although these installations were the first on open highways of California, the division of highways in that state has installed sodium vapor lights at 34 locations, chiefly underpasses, intersections and bridges.

The policy governing lights at intersections has been to install them where there were one or more of three hazards, namely: (1) where the element of surprise to the driver is accompanied by danger in stopping; (2) where "stop" signs are used against heavier traffic, especially at "Y" intersections and (3) where 4-way "stop" signs are required.

These policies are based on an 8-yr. study of accident records which indicate that the hazard in terms of vehicle miles traveled is much greater at night than during daylight hours. As these studies show that the causes of more than 50 per cent of the accidents fall into the following three classes, (1) "Driver had been drinking", (2) "Speed excessive for conditions", and (3) "Improper passing", it is expected that accident figures compiled before and after the lamp installations will show the extent to which absence of daylight is a contributing factor.

The Public Works Parley

Current problems in municipal practice were aired in the three-day session of the American Public Works Association

BREAKING AWAY from the time-honored and trite "key to the city" form of welcome, Mayor F. H. LaGuardia opened the 44th annual convention of the American Public Works Association in New York on Oct. 3 with a discussion on new concepts of public works administration and practice. Surprised and delighted by this unusual turn of events, the 325 delegates heard the head of the nation's largest city make constructive recommendations for improving public service facilities and personnel. This set the stage for a three-day session during which problems involving traffic and parking control, street lighting standards, snow removal, waste and sewage disposal, motor equipment maintenance, and road design and safety were paraded.

"I wonder what the public works convention was like forty years ago," said Mayor LaGuardia, recalling that public works activities have always held a strong appeal for politicians. Conditions have changed, he said, and it becomes increasingly evident that only trained and experienced career men can provide the type of service which the public demands in its municipal government operation. To foster the further development of professional careers in public works administration, the mayor suggested that an arrangement should be worked out whereby interchange of men between cities could be made.

Relations between the federal government and municipalities are closer than ever before, continued the Mayor, and the time is opportune to take steps toward pool purchasing of supplies, so that cities can take advantage of the lower prices quoted on federal contracts. To make possible such an arrangement it was said that a bill will be introduced in the next Congress seeking the amendment of the federal purchasing act.

It was not until New York City adopted a new charter, the provisions of which went into effect on Jan. 1 of this year, that public works engineering in the city was centralized in a single department, said Edward J. McGrew, Jr., deputy commissioner. It has taken almost half a century to consolidate public works functions and allocate them under a departmental form of organization. The final step was the creation of the public works department, which is responsible for the design, construction and operation of bridges, sewage disposal plants and intercepting sewers, and the construction of public buildings such as firehouses and hospitals.

The depression introduced a new era in public works administration, said Mr. McGrew, by focusing attention on the use of an "authority" to finance and build large-scale projects without employing municipal credit. Examples in New York are the Triborough Bridge, tunnel, parkway and housing authorities.

Equipment maintenance

The task of maintaining and servicing the 3,800 pieces of motor equipment used by the New York Department of Sanitation in collecting waste and keeping the streets clean was outlined by Loron G. Kurtz, deputy commissioner. The principal effort of the department is directed toward the postponement of major repairs and to this end attention is focused on preventive maintenance, training of operators to familiarize them with their units, and safety instruction.

Preventive maintenance, explained Mr. Kurtz, is a system of inspection and checking which is given to all motor vehicles. The unit is taken out of service one day each month, during which the operator reports to the city repair shop. Here he cleans and lubricates the engine and chassis and a skilled mechanic makes an inspection and test covering 43 items that are subject to wear or changes in adjustment. No man is assigned to operate equipment until he has satisfactorily passed a course of instruction in the use of that particular unit.

In Washington, D. C., special attention also is given to preventive maintenance, said William A. Xanten, supervisor of the city refuse division. Not only does the periodic checking and servicing of vehicles postpone major repairs, but it likewise minimizes the possibility of breakdowns that might seriously hamper and delay operation.

To insure safe operation of city motor vehicles, Rochester, N. Y., grants a one-half day vacation with pay for every month in the year in which a driver does not have a preventable accident, according to Frank Rowe, supervisor of motor vehicle equipment in that city.

Garbage disposal

Disposal of garbage by fermentation is admirably adapted to the needs of smaller municipalities, according to Arthur Boniface, village engineer and manager, Scarsdale, N. Y. Important new developments in this method of disposal have taken place in England and Italy where research has been directed toward the "seeding" of garbage with a liquid containing bacterial inoculations. This has reduced the time cycle of decomposition by 25 to 50 per cent.

Results at a small fermentation plant built in this country in 1923 were not particularly good, said Mr. Boniface, but modifications in operation have since corrected deficiencies. Among other things, it has been found desirable to control the acid reaction of the fermenting mass by means of lime, and to make provision in the fermentation cell for aeration following the initial anaerobic stage

of decomposition. Humus suitable for fertilizer is produced from garbage in a 28-day period.

Lansing, Mich., is one of the few communities in this country which uses the can system of collection, the operation of which was described by S. C. Jacka, city engineer. The city rents receptacles to householders at $1.50 per year. When the filled cans are collected, they are replaced with a clean can that has been washed and steamed. At the present time 13,842 cans are in service. (*ENR* June 2, 1938, p. 788).

The garbage is sent to a hog farm, but after July 1, 1939, it will be disposed of at a new municipal sewage treatment plant. Special facilities at this plant provide for the grinding of garbage following which it will be discharged into digestion tanks along with sewage sludge. (*ENR* June 23, 1938, p. 878). This is the first plant in this country to adopt permanently this method of garbage disposal.

Sewage problems

Construction of municipal sewage disposal facilities without regard for the treatment of industrial wastes only half solves the stream pollution problem, said E. J. Cleary, assistant editor, *Engineering News-Record*, who urged that municipal officials assume responsibility for cooperating with industries in providing proper disposal. What form this cooperation should take varies with conditions in each individual community: in Greensboro, N. C., it was found desirable to install special treatment devices in the municipal plant for which industries paid part of the cost (*ENR* Sept. 1, 1938); at Durham, N. C., on the other hand, industries pre-treat their wastes in their own plants so that the effluent is amenable to subsequent treatment at the municipal works.

The weakest point in sewage treatment programs today, said C. E. Keefer, principal assistant engineer, Baltimore, is the failure to provide sufficient funds for operation. To end this unsatisfactory condition—under which the best designed plant will fall far short of what is required of it—he suggested that the public be made better acquainted with the functions and objectives of sewage treatment works.

Paul Hansen, consulting engineer, Chicago, said that eagerness of engineers to provide disposal plants with sufficient capacity to meet future requirements has, in some cases, resulted in the construction of oversize plants. To avoid tying up capital funds in this manner, plants can and should be designed so that additional units can be added only as needed.

Air conditioning waste water which is discharged into sewers creates a serious problem for municipal officials, said Loran G. Gayton, city engineer, Chicago. In Chicago this additional load has not only overtaxed sewers in the business area of the city so that basements have been flooded, but the total flow to be handled at the treatment plant has been increased by 10 per cent. This has added considerably to operating costs because the sewage must be pumped against a head of 68 ft.

In some cases the addition of air conditioning waste water to the sewage flow may be helpful in securing better plant operation, according to L. H. Enslow, editor of *Water Works and Sewerage*. This is particularly true when the activated sludge process is used because the clean water adds to the oxygen content of the sewage and thus assists purification.

Street lighting

Scoring the present status of municipal street lighting, Elsworth Francisco, Bureau of Lighting, Newark, N. J., said the situation could be summed up in one word—inadequate; inadequate in amount, and inadequate from the viewpoint of applying fundamental principles of illumination practice.

Standard specifications now available in the Code of Street Lighting prepared by the Illuminating Engineering Society leave no excuse for the application of "hit or excuse" methods in designing installations, said Mr. Francisco, who recommended the code as an unbiased document and a competent guide for correct practice in standardizing street illumination.

Looking squarely at the facts, said A. J. Sweet, consulting engineer, New York, the real reason why public officials don't champion better street lighting is because by so doing they may lose their jobs. The only way to improve service without increased cost is to expose the extravagant and waste present practices, said Mr. Sweet, and since private utilities who furnish street lighting in most cities are a power in politics, it is considered unhealthy to recommend changes.

Streets designed for safety

Physical corrections and regulatory measures that can be applied to improve safety on streets were outlined by D. Grant Mickle, assistant director of the Michigan Highway Planning Survey, who stated that the first consideration should be given to more efficient use of present facilities in cities where improvements are being planned.

Widening of streets to increase capacity is not the only remedy to relieve overcrowding, said Mr. Mickle. Excess traffic in one location may frequently result because other streets are inadequate or non-existent. On streets where parking is permitted, 14 to 27 ft. of space is thus occupied, with consequent reduction in effective use of these streets for traffic movement. Intersections exert a valve action on traffic but the difficulty may be minimized by widening the roadway at these points, through the elimination of curb parking near the corners, or by special devices to encourage "channelization" of traffic.

Studies in Michigan on rural highway design indicate that travel safety will be promoted by increasing lane width from 10 to 11 ft. Sidewalks for pedestrians and better intersection facilities were held to be essential on highways passing through suburban districts.

Street intersections can be improved to facilitate traffic movement by abandoning the old standard of 13 ft. curb radius for radii of 20 to 40 ft., according to Henry Howe, city engineer, Rochester.

George M. Sheppard, chief engineer, Department of Public Works, St. Paul, stated that engineers could not keep out of the highly controversial subject of traffic control because the manner in which a street is designed in many ways affects the movement of traffic.

Traffic control

Since traffic control problems cannot be corrected by engineering means alone or through police regulatory activities alone, it would be logical to establish an independent traffic engineering agency as a major

unit in local government, according to Robert A. Mitchell, traffic engineer, Philadelphia. This agency would serve to coordinate the engineering phases of the work (such as design and erection of control equipment and use of street areas), with the enforcement measures handled by the police department. At the present time the responsibility for traffic control in our cities is divided—about half of them leave this in the hands of the police while in the remainder the city engineering department shoulders the duty.

In endorsing the view that traffic engineering should be handled by a separate agency, H. F. Hammond, director, traffic division, National Conservation Bureau, New York, pointed out that the principal reason why police departments have taken over this work is because no one else was prepared to do so. Intelligent law enforcement, however, is only one phase of traffic control. Proper solution of traffic problems demands an engineering approach, and policemen are not trained in this technique.

Snow removal experiences

Drawing upon a rich store of experience in snow removal operations, E. A. Miller, supervisor of maintenance, Rochester, N. Y., enumerated some of the practices which he considered as essential. First on the list is the establishment of close contact with the local weather man so that equipment and organization can be manned in advance of storms. Organization of personnel and the planning of routes for most effective action is the next step to be considered, and finally, first-class equipment must be provided to do the job required.

The value of rendering special service should not be overlooked, said Mr. Miller. This includes removing snow from pavements and sidewalks in front of houses where funerals are to be conducted and the prompt cleaning of streets where churches are located.

Preplanning is a vital element in the success of a snow fighting campaign, said John S. Flockhart, principal assistant engineer, Newark, N. J., but because of the emergency nature of the work every detail cannot be foreseen. Therefore, it is essential to make careful selection of men for key positions in the organization; they should have initiative and qualities of leadership as well as technical knowledge of the job in which they are engaged.

Asphalt street repairs

Successful results in asphalt street repair operation depend largely on attention to details of method, according to D. Benton Biser, director of the Commission of Governmental Efficiency and Economy, Baltimore, who based his conclusions on a field survey of practice in eleven cities. Contrary to general opinion, such factors as ownership of a mixing plant (public or private), the agency doing the work (city forces or contractor), and the type of asphaltic material (natural or oil-refined) have little bearing on the cost and quality of the repairs. Best results, it was said, were obtained when up-to-date equipment was employed such as air driven tools, slow speed rollers, and carefully regulated mixing plants. Details of workmanship involve: careful cleaning of edges before coating them with asphalt cement; thorough compaction with rollers; use of hand tampers where adequate rolling was impossible; prevention of overlapping joints with irregular and feather-edge flaps.

Championing the municipally-owned asphalt plant, George W. Andress, engineer in charge, Bureau of Streets, Newark, N. J., stated that in his experience the cost of production is only slightly higher than prices asked by private contractors. Furthermore, a municipal plant makes it possible to give prompt attention to repairs which otherwise would remain uncared for until a sizable accumulation of work justifies the calling of bids from private contractors. This delay frequently leads to an enlargement of the damage due to the effects of traffic and weather.

Speaking for the smaller community, Walter E. Rosengarten, engineer, Lower Merion Township, Pa., said that they cannot afford nor do they have sufficient work to justify construction of an asphalt plant. During the winter months when the contractor's plant is shut down, some difficulties are experienced in making repairs, but emergency patches can be made with cold-mix material. Use of air-operated cutting tools and tampers has greatly improved the quality of street repairs and, in addition, has lowered costs.

Helpful suggestions in the allocation of space for underground structures were made by George R. Thompson, city engineer, Detroit, who said that the chaotic state of affairs existing in every city might be remedied by the establishment of a centralized agency to control and regulate all underground installations. Experience in Detroit has indicated the logic of placing water and gas services under sidewalks, and locating street lighting conduits under walks immediately adjacent to the curb.

A study of the cost of providing duplicate water services on each side of a street, taking into account the length of tap required, showed that double lines become less costly than a single line depending on the width of a street. For example, an 8-in. single main in a 60-ft. street, complete with taps, was estimated to cost $3.37 per lin.ft. of street, which was less than a double line of 6-in. pipe at $4.25. In a 120-ft. street, however, the conditions are reversed, since the 8-in. line costs $4.50 against $4.25 for the duplicate 6-in. line. Similar studies on sewers reveal that in 80-ft. streets the double line costs less than the single sewer until the demand is reached for 24-in. pipe. In the 100 and 120-ft. streets, the double sewer in all cases is less expensive than the single.

Control of pavement cuts

How pavement openings are controlled and regulated in Cincinnati was described by Charles E. Brokaw, superintendent of highway maintenance. The most important element of control is the stipulation that no opening may be made without first securing a permit issued by the Director of Public Works. The permit application form contains space for listing extensive information on the nature and purposes of the proposed cut. After approval, the issuance of the permit is conditioned on the payment of a cash deposit sufficient to cover the estimated cost of restoration of the opening.

Although the city prefers to handle all restoration work with its own forces, contractors may do the job provided they will assume responsibility for the condition of the pavement indefinitely. This stipulation, plus rigid inspection, assures satisfactory performance.

Other papers on the program included an appraisal of the accomplishments of the WPA, by Perry A. Fellows, assistant chief engineer, Works Progress Administration, Washington; an interpretation of data collected from highway planning surveys by Herbert F. Fairbank, chief, division of information, U. S. Bureau of Public Roads, Washington; and a review of the public education campaign to aid street sanitation in New York, by Matthew Napear, secretary of the Department of Sanitation, New York City, N. Y.

A panel discussion on traffic and parking control was conducted by Roy L. Phillips, city engineer, Meadville, Pa., with the aid of Paul Oppermann, assistant director, American Society of Planning Officials, Theodore E. Transeau, assistant director, Department of Public Safety, Philadelphia, Edward F. Koester, survey and traffic engineer, Wilmington, Del., and Theodore M. Matson, Bureau for Street Traffic Research, Yale University.

Street repair and maintenance problems were the subject of another panel discussion led by William B. Shafer, superintendent of highways and sewers, Pittsburgh.

The following took part in the supplementary comment: Guy C. DeWitt, assistant city engineer, Utica, N. Y., Frank J. Hartmann, director of public works, Camden, N. J., Leon F. Peck, superintendent of streets, Metropolitan District, Hartford, Conn., and Thomas E. Collins, city engineer, Elizabeth, N. J.

On and Off the Convention Floor

Declaring that politics should be divorced from public works, Mayor LaGuardia said, "There is no Democratic or Republican way to dig a foundation or build a bridge." Judging from the expression on the faces of some delegates, they had reason to think otherwise.

When a snowstorm hits Rochester, expectant mothers become a special concern of the Public Works Department, according to Ed Miller, supervisor of maintenance. A special squad is assigned to clear snow from the streets and sidewalks at homes where a visit from the stork is expected.

After hearing Ed McGrew, Deputy Commissioner of the New York Department of Sanitation, tell that at one time street cleaning operations in the city were conducted by the Police Department, it seemed evident the meeting's controversial question on whether traffic control engineering should be in the police or engineering department would answer itself in due course.

Mark Owen, former commissioner of public works at Dearborn, and now vice president of the Nichols Engineering Co., took great pride in his exhibit of a sludge incinerator model—and for good reason. This little machine is an exact replica of a plant installation—and it costs almost as much, too!

Those who think that the fermentation process of municipal garbage disposal has passed into the limbo, should talk with Arthur Boniface, engineer and manager of Scarsdale, N. Y. New developments abroad concerned principally with the inoculation of garbage with bacteria culture are promising, he reported.

The happy expression on the face of Stan Pinel, research director of the A.P.W.A., was the result of many well-deserved compliments concerning the manual of street cleaning practice just gotten out by the association. Pinel not only edited the book but took most of the pictures used in it.

If one m.g.d. of water is required for an air conditioning load of 196 tons, what are the requirements for taking care of 3,731 tons in one city block that is completely air conditioned? In asking this, Loran G. Gayton, city engineer of Chicago, was not propounding a problem in arithmetic but one concerned with sewerage facilities. With his sewers already flooded he is wondering what the future holds.

Time marches on: In 1699 the sanitation budget in New York City was $40; in 1937 it was $29,000,000, according to Matthew Napear, secretary of the Department of Sanitation.

Those new "Curb Your Dog" signs which are displayed on all street corners of New York intrigued out-of-town delegates. Many were led to wonder who the unnamed genius was that originated the slogan.

Intimate glimpses of the life and love of a mosquito were provided in an exihibit of control measures arranged by Russ Gies, sanitary engineer of the New York Department of Health. A bottle full of lively specimens in all stages of development proved to be a major attraction to everyone except the New Jerseyites.

Public officials were urged by Walter Millard, National Municipal League, to become courteous listeners. Mr. Millard recalled the advice of an Assyrian king 2,000 years ago: People are happier in the telling of a complaint than they are in the remedy. If this be true, it would lighten the burden of many a public works administrator.

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Hexagonal Timber Culvert

A hexagonal culvert made up of timbers available on the job met usual requirements at Boca Dam in California where a construction road for heavy equipment had to pass over a small stream near the dam. The hexagonal section was chosen because (1) in this form the timbers could be fastened together effectively in the dry and then placed bodily, (2) piling was not feasible because of the hard bottom and (3) the prefabricated timber structure would be relatively inexpensive. The culvert was in service 8 days after its construction started and loads up to 60 tons have used it safely.

Streamflow conditions called for a culvert of 12-ft. diameter. With a soft fill around it and risk of side pressures, a hexagonal timber frame greatly increases the safety factor as compared to any rectangular construction. Timbers of the hexagonal frame were firmly spiked and drift-bolted together in two 18-ft. sections. The stream channel here traverses a cemented gravel formation and it was only necessary to cut away the bottom of the channel to fit the external form of the lower part of the culvert. The two sections were set in place with a crane and bolted together. Around and over them an earthfill was placed and carried up to a depth of 3 ft. above the culvert arch.

The culvert was designed and built by R. H. Sundwall, of the George W. Condon Company, contractors on the Boca earthfill dam.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

BARGE CANAL WORK, NEW YORK

OWNER: New York State Department of Public Works; Thomas Farrell, chief engineer.

PROJECT: Excavating in New York State barge canal from Lock No. 2 to guard gate No. 2 at Waterford in Saratoga County, and replacing concrete floor between locks 2 and 3. Excavation entails deepening the canal from 12 ft. to 14 ft. Contract is to be performed while the canal is closed to traffic. Transportation facilities by rail, highway and water are available.

BIDS: Ten bids were opened Sept. 27, 1938, ranging from $212,940 to $626,950. Minimum labor rates are as follows: skilled, 75c. per hr.; semi-skilled, 55c. per hr.; common, 45c. per hr.

LOW BIDDERS:

1. Collins Bros., Inc., Mechanicville, N. Y.... $212,940
2. Callanan Road Improvement Co., South Bethlehem, N. Y..... 281,700
3. Bates & Rogers Construction Corp., Chicago, Ill. 321,850

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav. other than ledge rock	60,000 c. y.	$0.56	$1.00	$0.90
2. Excav. ledge rock incl. conc. floor and ref. wall.....	129,000 c. y.	.88	1.00	1.15
3. Second cl. conc.....	4,500 c. y.	10.00	11.00	17.50
4. Drilling line holes along channel and structures.	5,800 l. f.	1.90	4.00	1.25
5. Pumping, bailing draining.	L. S.	1,000.00	10,000.00	22,000.00

CONCRETE HIGHWAY, WASHINGTON

OWNER: Washington State Highway Department; L. V. Murrow, director.

PROJECT: Construction of 4.79 mi. of concrete pavement on state highway No. 2, King county. Project consists mostly in widening from 27 ft. to 44 ft. the existing concrete road, adding 8-ft. 6-in. on each side. Job is at the city limits of Seattle so that it is near the distributing center for all materials. Conditions are favorable for low costs. Wages are as follows: skilled, $1.20 per hr.; semi-skilled, 75c. per hr.; common, 50c. per hr. Stipulated contract time is 300 calendar days. Transportation facilities by rail, highway and water are available.

BIDS: Three bids were received Sept. 7, 1938, ranging from the contract low of $282,198 to $297,952.

LOW BIDDERS:

1. L. J. Dowell, Inc., Seattle (contract)..... $282,198
2. Northwest Construction Co., Inc., Seattle..... 289,409
3. Fiorito Bros., Inc., Seattle..... 297,952

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing.....	33 acres	$150.00	$160.00	$150.00
2. Grubbing.....	22 acres	150.00	160.00	150.00
3. Uncl. excav. incl. 600 pt. haul.....	164,600 c. y.	.28	.26	.30
4. Struct. excav.....	8,930 c. y.	1.10	1.00	.80
5. Cl. "D" excav.....	1,170 c. y.	$1.25	$1.25	$.80
6. Overhaul on above materials.....	50,620 sta. y.	.01	.01	.01
7. Overhaul on above materials and selected rdy. borrow.....	263,960 yd. mi.	.10	.08	.10
8. Slope treatment.....	24,050 l. f.	.10	.08	.15
9. Finish. roadway.....	301 sta.	10.00	10.00	10.00
10. Gravel backfill.....	2,050 c. y.	2.25	2.25	2.50
11. Select. roadway borrow except haul.....	43,790 c. y.	.20	.22	.25
12. Cr. stone surf. top course.	4,610 c. y.	2.25	2.25	2.50
13. Cr. stone surf. base course.	2,940 c. y.	2.25	2.50	2.50
14. Sand filler inc. haul.....	500 c. y.	.50	1.00	1.50
15. Water.....	48 m. g.	2.00	3.00	3.00
16. Conc. pavt. std. 14-day mix.....	39,985 s. y.	1.70	1.85	1.89
17. Conc. pavt. high early str.	5,371 s. y.	1.90	2.00	2.10
18. Conc. pavt. high early str.	1,745 s. y.	2.05	2.25	2.19
19. Conc. pavt. high early str. Type "B".....	2,150 s. y.	2.15	2.10	2.20
20. Conc. pavt. br. app. slabs-std. 14-day mix.....	45 c. y.	11.00	10.00	11.00
21. Conc. driveway (std. 14-day mix).....	470 s. y.	1.70	1.70	1.50
22. Conc. driveway (high early str.).....	997 s. y.	1.90	1.80	1.65
23. Conc. driveway (high early str.) Type "B".....	524 s. y.	2.05	1.90	1.75
24. One course conc. sidewalk (std. 14-day mix).....	6,839 s. y.	1.10	1.40	1.20
25. Dowel bars with rubber caps.....	5,800 ea.	.20	.25	.19
26. Dowel bars without caps.	26,039 ea.	.11	.13	.10
27. Pav. reinf. type 2.....	15,860 lb.	.055	.06	.05
28. Sp. conc. curb and gutter.	16,155 l. f.	.65	.65	.75
29. Integ. conc. curb.....	595 l. f.	.20	.25	.20
30. Reinf. conc. gutter.....	75 l. f.	.75	.80	.75
31. Pav. header 3.....	82 l. f.	1.00	1.50	1.00
32. Temp. bridges across pavt.	3 ea.	40.00	40.00	40.00
33. Cable guard rail.....	7,445 l. f.	.65	.65	.60
34. Log bull rail.....	218 l. f.	.75	.80	.60
35. Lumber (untr.).....	4 m. b. m.	50.00	70.00	48.00
36. Conc. cl. "A".....	169 c. y.	30.00	30.00	32.00
37. Conc. cl. "B".....	29 c. y.	30.00	30.00	27.00
38. Conc. cl. "C".....	22 c. y.	30.00	30.00	18.00
39. St. reinf.....	30,330 lb.	.055	.06	.055
40. Hand-placed riprap.....	26 c. y.	5.00	10.00	10.00
41. Reinf. right of way markers	118 ea.	1.75	2.00	1.85
42. Reinf. Federal aid markers.	1 ea.	10.00	10.00	7.50
43. Std. conc. or brick manhole under 8 ft. complete.	10 ea.	75.00	90.00	80.00
44. Std. conc. or brick manhole over 8 ft. complete.	3 ea.	85.00	125.00	95.00
45. C. I. manhole ring and cover complete.....	3 ea.	20.00	30.00	15.00
46. Sp. Conc. inlet with cast iron frame and grate, complete.....	24 ea.	35.00	40.00	25.00
47. Sp. conc. catch basin with C.I. cover.....	21 ea.	35.00	50.00	40.00
48. Sp. brick elliptical catch basin with C.I. frame and grate.....	22 ea.	65.00	80.00	50.00
49. Sp. wood sand box.....	9 ea.	40.00	60.00	80.00
50. Adjusting exist. manholes and catch basins to grade	12 ea.	8.00	15.00	5.00
51. Std. manhole covers.....	3 ea.	5.00	20.00	15.00
52. Spec. fastenings for manhole covers complete...	16 ea.	6.00	15.00	5.00
53. Remov. exist. inlets.....	2 ea.	5.00	15.00	7.00
54. Remov. exist. conc. catch basins.....	21 ea.	5.00	15.00	15.00
55. Remov. exist. conc. pipe headers.....	15 ea.	5.00	10.00	5.00
56. Remov. exist. brick catch basins or manholes.....	2 ea.	5.00	20.00	15.00
57. Remov. exist. conc. pav...	2,344 s. y.	.25	.50	.20
58. Remov. exist conc. driveways.....	705 s. y.	.25	.50	.20
59. Remov. exist. conc. sidewalks and steps.....	751 s. y.	.20	.50	.20
60. Remov. exist. asphalt pav.	2,083 s. y.	.20	.40	.20
61. Remov. exist. conc. curb..	1,155 l. f.	.20	.10	.15
62. Remov. exist. reinf. concrete gutter.....	11,948 l. f.	.20	.20	.12
63. Remov. exist. guard rail..	6,690 l. f.	.05	.10	.10
64. Remov. exist. wood flume.	613 l. f.	.05	.10	.05
65. Remov. exist. wood headers	1,205 l. f.	.05	.10	.25
66. Remov. exist. cem. rubble walls and posts (2).....	L. S.	5.00	50.00	20.00
67. Remov. exist. plank driveways and sidewalks (5).	L. S.	300.00	300.00	25.00
68. Remov. exist. pile and timber bulkheads and cribs (3).....	L. S.	200.00	300.00	25.00
69. Remov. exist. conc. foundations (gas pump).....	L. S.	10.00	25.00	20.00
70. Remov. and backfilling exist. 3 x 3 ft. wood box culvert.....	L. S.	50.00	100.00	15.00
71. Reset. exist. conc. catch basins.....	7 ea.	10.00	30.00	35.00

(Contract Unit Prices continued on next page)

(*Contract Unit Prices Continued from p. 505*)

Item	Quan.	Unit Prices (1)	(2)	(3)
72. Reset. and repainting exist. guard rail type no. 2	1,290 l. f.	.20	.30	.20
73. Reset. and repainting exist. guard rail type No. 4	390 l. f.	.25	.30	.22
74. 12 in. half round corr. metal flume No. 16 gage	255 l. f.	.75	1.50	1.25
75. Relay. exist. conc. or V.C. pipe 8 in	130 l. f.	.25	.30	.50
76. Relay. exist. drain pipe 8 in.	725 l. f.	.15	.30	.40
77. Relay. exist. conc. pipe 12 in	3,349 l. f.	.25	.40	.35
78. Relay. exist. conc. pipe 18 in	117 l. f.	.40	1.00	.50
79. Drain pipe 6 in	509 l. f.	.25	.25	.30
80. Drain pipe, 8 in	2,906 l. f.	.35	.35	.30
81. Pl. conc. or V.C. sewer pipe 6 in	45 l. f.	.35	.35	.35
82. Pl. conc. or V.C. sewer pipe 8 in	470 l. f.	.40	.40	.35
83. Pl.conc. or V.C. sewer pipe 12 in	5,979 l. f.	.55	.50	.43
84. Pl. conc. or V.C. culvert pipe 12 in	786 l. f.	.65	.70	.60
85. Std. reinf. conc. culvert pipe 12 in	45 l. f.	1.00	1.00	1.00
86. Std. reinf. conc. culvert pipe 18 in	657 l. f.	1.50	1.60	1.45
87. Std. reinf. conc. culvert pipe 24 in	96 l. f.	2.40	3.00	2.50
88. Std. reinf. conc. culvert pipe 30 in	249 l. f.	3.50	3.50	5.00
89. Std. reinf. conc. culvert pipe 36 in	30 l. f.	6.00	6.50	10.00
90. Dipped corr. iron pipe No. 16 gage 8 in	746 l. f.	1.00	1.00	.80
91. Dipped corr. iron pipe No. 16 gage 12 in	16 l. f.	1.50	1.50	1.50
92. Type I-1 asph. conc. pavt. class "C" wearing course	50 tons	9.00	9.00	8.65
93. Type I-1 asph. conc. pavt. class "E" base course	149 tons	9.00	9.00	8.65
BRIDGE WIDENING				
94. Struct. excav	120 c. y.	2.00	3.00	2.00
95. Conc. cl. "B"	125 c. y.	30.00	28.00	30.00
96. Reinf	12,000 lb.	.06	.06	.06
97. Cinch anchors	40 ea.	5.00	6.00	5.50
98. Remov. exist. wing walls	L. S.	200.00	200.00	150.00

SEWERS, SAUGUS, MASS.

OWNER: Town of Saugus; C. E. Flynn, chairman of Sewer Commission; Fay Spofford and Thorndike, Boston, engineers.

PROJECT: Constructing intercepting sewers and other sewers in various streets of Saugus, totaling 12,700 ft. in sizes from 8 in. to 30 in. Depth of cut varies from 7 ft. to 22 ft. Completion is scheduled by Aug. 31, 1939. Transportation facilities by rail and highway are available.

BIDS: Eighteen bids were received Aug. 30, 1938, ranging from the contract low of $143,713 to $261,342. Minimum labor rates are as follows: skilled, $1.00 per hr.; semi-skilled, 65c. per hr.; common, 60c. per hr.

LOW BIDDERS:

1. V. Barletta Co., Roslindale, Mass. (contract) . $143,713
2. I. Capaldi & Sons, Inc., Providence 144,515
3. A. Baruffaldi Co., Somerville, Mass. 151,103

Item	Quan.	Unit Prices (1)	(2)	(3)
1. 30-in. R.C. pipe sewer	5,000 l. f.	$11.75	$12.00	$15.00
2. 24-in. R.C. pipe sewer	1,400 l. f.	7.00	8.00	8.00
3. 15-in. Vit. pipe sewer	2,000 l. f.	7.75	3.25	7.00
4. 10-in. Vit. pipe sewer	100 l. f.	3.00	2.00	5.00
5. 8-in. Vit. pipe sewer	4,200 l. f.	2.00	1.75	2.00
6. Vit. pipe underdrain	9,000 l. f.	.70	1.00	.50
7. 6-in. service connections	4,100 l. f.	1.50	1.00	.80
8. 6-in. Y branch	160 ea.	3.00	3.00	3.00
9. Pipe chimney	50 ea.	12.00	25.00	5.00
10. Standard and drop manhole	60 ea.	90.00	130.00	100.00
11. Rock excav	1,500 c. y.	5.00	6.00	1.00
12. Earth excav. below grade	200 c. y.	3.00	3.00	4.00
13. Select. mat	600 c. y.	1.00	2.00	1.00
14. Conc. masonry	250 c. y.	10.00	18.00	10.00
15. Lumber, sheeting, pile caps	200 M.b.m.	45.00	38.00	35.00
16. Brick masonry	30 c. y.	20.00	30.00	25.00
17. Reinf. steel	1,000 lb.	.04	.07	.05
18. Wood piles	1,000 l. f.	1.00	.90	.40
19. Rubble stone paving	100 s. y.	1.50	2.50	1.50
20. Cold patch paving	1,000 s. y.	.90	1.00	.75
21. Bit. mac. paving	2,000 s. y.	1.25	1.50	1.00
22. Temp. pav	3,000 s. y.	.40	.80	.50
23. Project signs	3 ea.	40.00	60.00	20.00
24. Traffic police	200 man-days	6.00	7.00	6.00
25. Pumping and care of flow of streams and sewers	L. S.	1,000.00	500.00	3,000.00
26. Prep. at site, cleaning up, etc	L. S.	1,000.00	1,000.00	2,233.05

DRAINAGE WORK, CALIFORNIA

OWNER: Oxnard Drainage District No. 3; S. G. Bennett, Santa Paula, engineer.

PROJECT: Constructing canals, ditches, and miscellaneous structures for Oxnard Drainage District. Stipulated contract time is 150 days, work to start Sept. 30, 1938. Transportation facilities by rail and highway are available.

BIDS: Fourteen bids were received Sept. 10, 1938, ranging from the contract low of $46,487 to $109,425. Labor rates are as follows: skilled, $1.00 per hr.; semi-skilled, 60c. per hr.; common, 50c. per hr.

LOW BIDDERS:

1. R. Schweitzer, Los Angeles (contract) $46,487
2. T. G. Smith and E. G. Perham 52,478
3. Spicer and Thompson 56,060

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav	300,000 c. y.	$0.05	$0.06	$0.09
2. Struct. excav	3,000 c. y.	.50	1.50	1.00
3. Cl. "A" conc	210 c. y.	24.15	32.00	30.00
4. Tr. Douglas fir piles	6,780 l. f.	1.11	1.25	.90
5. Untr. Douglas fir piles	720 l. f.	.85	1.10	.70
6. Untr. Douglas fir sheet piling	10 M.b.m.	119.04	90.00	60.00
7. Redwood	7 M.b.m.	160.10	150.00	90.00
8. Tr. Douglas fir	57 M.b.m.	108.00	100.00	85.00
9. Reinf. steel	30,000 lb.	.10	.06	.085
10. Tide gates	6 ea.	89.20	100.00	100.00
11. Steel pipe (7-in. welded)	73 l. f.	6.56	6.00	8.00
12. Cor. pipe (24-in.)	700 l. f.	2.40	2.75	2.50
13. Misc. hardware	6 tons	143.90	210.00	240.00
14. Bridge surf	21 tons	9.46	8.00	5.00
15. Drain tile (4-in)	100 l. f.	.55	1.50	.50

BANK REVETMENT, OREGON

OWNER: U. S. Engineers, District Office, Portland, Ore.; C. R. Moore, district engineer.

PROJECT: Clearing, bank sloping, gravel borrow, excavation and construction of 5,400 ft. of rock revetment located at three sites in the lower 2½ miles of Santiam River in Marion County, Oregon. Labor rates are as follows: skilled, $1.25 per hr.; semi-skilled, $1.00 per hr.; common, $0.625 per hr. Stipulated contract time is 90 days. Transportation facilities by rail and highway are available.

BIDS: Eight bids were received Sept. 6, 1938, ranging from the contract low of $89,961 to $151,864.

LOW BIDDERS:

1. Kern & Kibbe, Portland, Ore. (contract) .... $ 89,961
2. Babler Bros., Portland 98,756
3. Joplin & Eldon, Portland 114,949

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing	5 acres	$300.00	$300.00	$250.00
2. Excav., type 2	27,600 c. y.	.27	.35	.34
3. Clearing	2 acres	300.00	500.00	500.00
4. Bank sloping	1,100 c. y.	.45	.25	.50
5. Excav., type 1	17,000 c. y.	.27	.25	.40
6. Gravel borrow	63,900 c. y.	.27	.35	.275
7. Stone for riprap revetment.	26,490 tons	1.82	1.85	2.25
8. Clearing	3 acres	300.00	300.00	400.00
9. Gravel borrow	28,000 c. y.	.32	.35	.40